TO



VIA FAX AND MAIL

BOARD OF DIRECTORS

Carla Bard

June 27, 1994

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**Executive Director** 

David Behar

Cay Goude

U.S. Fish and Wildlife Service

2800 Cottage Way Sacramento, CA

Dear Ms. Goude,

As you know, on February 22, 1994 The Bay Institute and eight other fishery and environmental organizations notified the Fish and Wildlife Service of their intent to file a lawsuit challenging the adequacy of the Service's 1994 biological opinion in ensuring that the continued existence of the delta smelt is not jeopardized by this year's operation of the CVP/SWP. We never received a response from the Service to our notice of intent to sue.

Of course, the inadequacy of the biological opinion has been amply demonstrated by the events of 1994 thus far: the vast majority of the smelt population has not been moved into suitable rearing habitat in Suisun Bay, and takes of smelt have been excessive. A sizable proportion of the population is now located within the zone of influence of the CVP/SWP pumps — an event that even the Service in the 1994 biological opinion admitted would jeopardize the continued existence of the smelt. This has further convinced the fishery and environmental organizations of both the strength of our lawsuit and the need to file it in the very near future.

Nevertheless, the filing of a suit is not an action The Bay Institute and other organizations welcome. Accordingly, on June 23 I contacted you in an attempt to resolve these organizations' concerns short of litigation.

The Bay Institute - Delta Smelt Biological Opinion February 22, 1994 Notice of Intent to Sue Page 2

I made a number of suggestions of ways in which we might resolve our differences short of legal action. The more thought I have given to your response, the more I feel that it was completely inadequate. Essentially, you held out no possibility that any of the actions I outlined were acceptable to the Service.

I urge you to reconsider your position. If we do not hear from you with a more credible offer to settle this issue by July 1, it is our intent to file suit on July 5.

Sincerely,

David Behar

**Executive Director** 

cc: Pacific Coast Federation of Fishermen's Associations
Golden Gate Fishermen's Association
United Anglers
Sierra Club
Friends of the River
Golden Gate Audubon Society
Sacramento River Preservation Trust
Sacramento River Council
Interested parties





# United States Department of the Interior

FISH AND WILDLIFE SERVICE

Sacramento/San Joaquin Estuary Fisheries Resource Office 4001 N. Wilson Way, Stockton, CA 95205 209-946-6400 (voice) 209-946-6355 (fax)

June 14, 1994

California Urban Water Agencies c/o Randy Bailey Bailey Environmental 3050 Meadow Creek Road Lincoln, CA 95648

Dear Randy,

This letter is being written to summarize our meeting on Monday, April 11, 1994 and to identify our concerns regarding your draft document entitled "A review of the Salmon Smolt Survival Index As Proposed by the U.S. Environmental Protection Agency As Water Quality Standards For The San Francisco Bay Estuary".

I would like to applaud your desire to help us refine our understanding of the factors controlling salmon smolt survival in the Delta and look forward to working with you through the EPA and SWRCB standard setting processes. Although we have some minor differences in how the model should be used, we are in agreement that the Delta salmon resources specifically, and the Bay/Delta aquatic resources in general, do need additional habitat protection.

As we provide information to the State Water Resources Control Board and EPA it is my goal to convey to them the general issues of agreement. For instance, we both agree that salmon smolts in the Delta could benefit from reduced temperatures, lower exports, increased flows (especially on the San Joaquin River) and prevention of diversion into less desirable areas (as the central and south delta). We are also in agreement that protective standards addressing these issues need to be adopted quickly before additional degradation of the salmon resources occur.

My responses to your document will first focus on your summary of primary conclusions.

1. "The index as proposed is not a water quality standard." We believe, as EPA does, that the concept of a smolt survival index can be used to protect this beneficial use. However,

this is actually a policy decision being made by EPA and is not related to the value of the model or the smolt survival indices in any way.

2. "The fundamental basis for the equations developed by the U.S. Fish and Wildlife Service and the Environmental Protection Agency to derive the smolt survival index is flawed." "...However, since the estimation of survival from the experimental data often exceeds 100%, the U.S. Fish and Wildlife Service has scaled the data by dividing all estimates by 1.8 in order to bring the survival estimates into the biologically meaningful range of 100% or less. According to Dr. John Rice...scaling the data by the largest experimental multiplier necessary to bring the survival estimates to unity or less invalidates their use as probabilities."

During our meeting in Stockton, we mutually agreed that Dr. John Rice would write up specifically, why he felt our data transformation (dividing by 1.8) should invalidate the use of smolt survival indices in EPA's proposed standards. As of yet we have not received that letter, and hope that having him do this is still your intention.

We do not feel that the data transformation does invalidate the use of the smolt survival indices as they are all indices of survival and how they perform in a relative manner is the key. Relative indices allow you to match historical levels of survival which are based on the same model equations.

3. "Even if the probability question raised in 2 above could be solved, the propagation of error throughout the entire mathematical sequence of estimations used by EPA to develop the salmon survival indices render the proposed standard values meaningless."

Again, we believe the smolt survival model is of value especially in a relative sense and can be used to modify or manage the variables we believe are important to smolt survival in the Delta. We believe it is the best model available and any modifications to improve its performance are welcomed.

4. "There are numerous mathematical results that can be calculated from the proposed standard, based on reasonable operational assumptions, that do not make any sense biologically."

As we stated in our 1989 model report (Kjelson et. al., 1989), "water temperature affects smolts both directly through acute (lethal) effects and indirectly through chronic (sublethal) effects.".."Chronic temperature effects are more difficult to quantify, but are those related to physiological stress, predator and smolt metabolic demands, disease, growth and other factors whose effects on smolt survival have been shown to increase with a rise in temperature (Hanson, 1989)." Our relationships in the model would incorporate both the acute and chronic effects of temperature on smolt survival and thus would not be expected to respond the same way as a relationship independent of the chronic effects on smolt survival. Field experiments give the net result of all factors affecting survival that are related to

temperature. We believe if temperature is reduced these sublethal effects would decline as well and net survival would increase.

In addition, higher temperature mortality in reach 2 is likely due to the smolts increased exposure time as the distance needed to successfully reach the ocean is increased.

You also state that "Until all of the factors affecting survival are incorporated into the estimates of survival, the use of the equations to develop salmon survival indices is patently invalid." Any model has it limitations because by its very nature it attempts to simplify complex biological systems using relatively simple mathematical equations. You have stated some of the shortcomings of our salmon smolt survival model, but we do not agree that it is possible or even desirable to incorporate all the factors affecting survival into a model or that developing salmon survival indices from the model is invalid.

As stated earlier, essentially all salmon biologist agree that decreasing the negative effects of high temperature, exports, and diversion off the mainstem rivers, will aid in improving salmon smolt survival in the delta. It is on this basis that we and DFG recommended specific measures in the July, 1992 State Board hearings for D-1630. The model provides a means whereby we attempted to quantify the benefits of those actions. While the model is imperfect in nature that imperfection does not negate the need to improve smolt survival through measures that are well supported by our CWT experiments and our basic understanding of salmon biology.

5. "None of the experimental data used to develop the various regression equations was based on very high flow data. Most fishery biologists would agree that exports would have a minimal effect on salmon smolt migration at very high flow conditions."

The first statement above is untrue, as 1980, 1982, 1983 and 1986 were used in the development of the model and were all high or extremely high flow years.

It is true, that survival was greater in those high flow years. When flow at Freeport is greater than 25,000 cfs the cross channel gates are closed. Also in these high flow years, temperatures were generally low and exports were in the midrange (3700 to 5200 cfs). Thus in these wet years a smaller percentage of smolts are diverted into the Central Delta and their survival in the interior Delta is greater than for the greater percentage of smolts diverted in a dry year. Overall survival in these wet years would be relatively high and is reflected as such in the model.

However, the effect of high exports (greater than 6000 cfs) on smolt survival during periods of high flow has not been measured and is outside the range of parameters used to develop the model.

6. "Given reasonable operational and flow conditions in the spring, the standard on the Sacramento River will be violated in most years because of the lack of influence of outflow

on water temperature at Freeport."

"Reasonable" is a subjective term and must be defined by SWRCB and EPA in their balancing of the levels of protection for the various beneficial uses.

The smolt survival standard was violated in 5 of the 29 years between 1962 and 1992 when exports and the percent diverted into the Central Delta was 0 per your Appendix B. The "smolt survival index" standard is based on an average for each water year type, and given the range incorporated into any mean, this is an expected outcome based on the average limitation. The smolt survival index for some years was lower than the standard during the target historical period as well. I believe it is EPA's intention to incorporate the index variability within each water year type into their implementation recommendations.

Your average temperature values between 1962-1970, were somewhat different than the actual temperatures used to generate the smolt survival index goals for the 1956-1970 period. Per our conversation of June 13, averaging monthly maximums and minimums and then generating a monthly mean derives different monthly averages than averaging each day over the course of the month as we used. This also may be part of the reason standards were unattainable in the 5 out of 29 years estimated.

The tables in your Appendix B entitled "Selected Operational Scenarios and Resulting Sacramento River Salmon Index (SRSI) Values", reflect various operational scenarios. Although you have discussed that the standard can not be meet in all years, you do not discuss or include in your tables scenarios that are representative of the way the projects have operated historically (with D1485 standards and the Four Pumps Agreement). The greatest P1 included in your tables has a value of 0.3 which only reflects closure of the Delta Cross Channel, but in most years both the Delta Cross Channel and Georgiana Slough divert smolts off the mainstem Sacramento River (a P1 value of 0.6 to 0.7).

Even given this unrealistic value of the percent diverted (0.3), in years where exports were 11,000 in April and 6,000 in May and June, violations of the proposed standard occurred in 16 of the 29 years. With the more representative estimate of the percent diverted in these years (0.7) (Appendix 1), violations occurred in all years. This table supports our contention that smolt survival through the Delta in most years can be significantly improved in the Delta (to levels present in the late 60's and early 70's) by controlling exports and the percent diverted.

Specific Comments in the remaining text:

Page 7, 1. Your comments are directed to the fact that our smolt survival indices are indices and not absolute estimates of survival. Changing the smolt survival indices by dividing them by a constant (using the trawl width (9.1 m) as we have done or by the effective trawl width (6.5, accounting for net efficiency) will not change the smolt survival

change.

- Page 7, 2. Indices of 100% have occurred using the trawl index of survival as well as the ocean index of survival in years where survival is high (wet years). We attribute this to variability in both indices for different reasons or to a bias in the wet years where it is advantageous for the smolts to be released in the North Delta versus Suisun Bay (Port Chicago or Benecia).
- Page 8, 3. In our meeting we discussed the problems with biological data of obtaining meaningful confidence intervals and asked to receive some guidance from your statistician in what could or should be done in these cases.
- "While this level of precision may be appropriate for management actions, the question of whether or not this level is acceptable for regulatory purposes needs to be examined." We believe that both management actions and regulatory measures should be based on the best available science.
- Page 8, 4.1: An evaluation was done in 1984, by Don Stevens, Marty Kjelson and Pat Brandes. In that analyses, it was determined that although there may be some bias from the difference in temperature between the stocking truck and the receiving waters, there was no consistent bias noted that would invalidate the conclusions based on the smolt survival indices. In addition, the fact that smolt survival through the Delta using both the trawl index and ocean index of survival are significantly correlated to each other supports the conclusion that we are successful in indexing smolt survival through the Delta using either method.
- Page 8-9, 4.2: All salmon smolts used in the generation of the Sacramento smolt model were from Feather River Hatchery origin. There were no mixing of stocks between years.
- Page 9, 5: We do not assume predation is constant at all water temperatures. We believe predation is a function of water temperature and that if water temperature is decreased, predation will decrease as well. Predation is a natural component of the ecosystem, and given a healthy and viable smolt population, predation in of itself would not control the population. Considering there is fewer predators (sublegal Striped Bass) now than in the last 25 years, it is very unlikely they are responsible for the decline of the natural population of chinook salmon. There may be more warmwater predators now than historically, but if temperatures were reduced, the number and success of warmwater predators would also be reduced.
- Page 9, 6: Wickwire and Stevens, 1971, evaluated the diurnal distribution of salmon smolts at Collinsville. They found that the smolts were more evenly distributed at night and more aggregated to the surface during the day. In our generation of smolt survival indices, we do not assume a random distribution throughout the water column, we assume a random horizontal distribution, with the vast majority of smolts near the surface during our day

we do not assume a random distribution throughout the water column, we assume a random horizontal distribution, with the vast majority of smolts near the surface during our day trawling. If more smolts are migrating at night, why do we index survival of over 1.0 for marked smolts when survival is high? It would seem that if we are missing a large component of the natural population because they are migrating at night, we would also miss a great number of the marked fish, which we apparently do not.

Page 10, 8: Typo's did occur in EPA's Proposed Rule and the correct coefficients are listed in your document.

Page 10, 9: "The water temperature at Freeport is relatively independent of water year type.." In our analyses we have found that on average water temperatures are related to water year type and we would like to see your analyses or a reference to the documentation that supports your claim to the contrary.

Martin A. Kjelson Project Leader

Mathia Kolson

cc: Heidi Bratovich- SWRCB
Susan Hatfield- EPA
Club Fed - ES-Sac-Wayne White
Jerry Grover- USFWS, AFF
Sheila Greene- CDWR
Debbie McKee- CDFG
Gary Stern -NMFS

TO: PAT BRANGES

appordix I

# Sacramento River Salmon Smolt Survival Index

		Temperature (F)			Index				Standard
Year*	Туре	April	May	June	April	May	June	Total	Met?
1962	BN	<b>5</b> 6.6	61.0	68.5	0.043	0.211	0.021	0.275	NO
1963	W	54.1	59.3	68.9	0.042	0.252	0.019	0.313	NO
1964	D	58.2	63.7	70.6	0.045	0.154	0.013	0.213	NO
1965	W	58.8	59.5	66.1	0.044	0.247	0.031	0.321	NO
1966	BN	57.6	65.9	68.0	0.045	0.114	0.022	0.181	NO
1967	W	49.8	58.1	60.9	0.045	0.273	0.059	0.377	NO
1968	BN	58.5	65.6	70.0	0.045	0.119	0.015	0.180	NO
1969	W	55.7	60.7	65.3	0.043	0.218	0.034	0.295	NO
1970	W	57.4	64.4	71.6	0.044	0.141	0.010	0.195	NO
1971	W	55.0	59.4	64.4	0.042	0.249	0.039	0.331	NO
1972	BN	58.1	65.6	69.6	0.045	0.119	0.017	0.181	NO
1973	AN	59.7	67.0	70.1	0.039	0.096	0.015	0.150	NO
1974	W	54.2	62.0	66.5	0.042	0.189	0.029	0.260	NO
1975	W	54.1	60.7	66.3	0.042	0.218	0.030	0.290	NO
1976	С	57.9	66.8	68.5	0.045	0.099	0.021	0.165	NO
1977	С	62.5	63.9	73.4	0.025	0.150	0.006	0.181	NO
1978	AN	57.1	63.0	70.0	0.044	0.168	0.015	0.227	NO
1979	BN	59.8	63.8	69.2	0.038	0.152	0.018	0.208	NO
1980	AN	57.1	63.6	66.9	0.044	0.156	0.027	0.227	NO
1981	D	61.5	66.7	71.9	0.030	0.101	0.010	0.140	NO
1982	W	54.0	61.1	66.0	0.042	0.209	0.031	0.282	NO
1983	W	55.0	60.1	69.2	0.042	0.232	0.018	0.293	NO
1984	W	59.7	6 <b>6</b> .5	68.4	0.039	0.104	0.021	0.164	NO
1985	D	62.5	65.1	70.9	0.025	0.128	0.012	0.165	NO
1986	W	59.8	65.8	71.6	0.038	0.116	0.010	0.164	NO
1987	D		70.7			0.047		0.047	N/A
1988	С	59.5	66.0	68.6	0.040	0.112	0.020	0.172	NO
1990	С	61.4	65.7	70.1	0.030	0.117	0.015	0.162	NO
1991	С	59.5	65. <b>5</b>	68.2	0.040	0.121	0.022	0.182	NO
1992	С	64.0	70.7	70.8	0.019	0.047	0.013	0.078	NO

Constants					
P1= 0.7					
P2= 0.3					

Exp	Exports						
April	11000						
May	6000						
June	6000						

Weighting							
April	0.17						
May	0.65						
June	0.18						

Index Value							
AN 0.38							
BN	0.36						
С	0.29						
D	0.32						
W	0.45						

<sup>\*1989</sup> missing due to insufficient data

#### STATE WATER RESOURCES CONTROL BOARD

PAUL R. BONDERSON BUILDING 901 P STREET, SACRAMENTO Mail Address: P. O. BOX 100 SACRAMENTO. CALIFORNIA 95812-0100 Phone: (916) 657-1873

Fax: (916) 657-1485



#### NOTICE OF PUBLIC WORKSHOP

Fourth Workshop to Review Standards for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary

July 13, 1994--10:00 AM (and July 14, 26 and 27, if necessary)

1416 Ninth Street, First Floor Auditorium Sacramento, California

#### SUBJECT OF WORKSHOP

The State Water Resources Control Board (SWRCB) is convening this workshop to seek comments and recommendations regarding standards for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Estuary or Delta).

#### **BACKGROUND AND SWRCB PROCESS**

This workshop is the fourth in a series of four workshops on the above subject. Previous workshops were held on April 26, May 16, and June 14. The background on this subject and the process for SWRCB action upon completion of this workshop series are described in the notice for the April workshop. If you need copies of the prior workshop notices, call Ellyn Sekul at (916) 657-1357.

#### **REGULATORY BASIS FOR ACTION**

California Water Code Section 13240 requires that water quality control plans adopted by the SWRCB must be periodically reviewed and may be revised. In addition, the Federal Clean Water Act requires a triennial review of water quality control plans.

The SWRCB is authorized to establish State policy for water quality control, including surface water management programs, by California Water Code Sections 13140 to 13142.

#### **KEY ISSUES**

1. What fish and wildlife standards should the SWRCB evaluate as alternatives in this review?

The SWRCB intends to evaluate a broad range of alternative fish and wildlife standards during this review. Numerous parameters characterize conditions in the Bay-Delta watershed, and many of these parameters can be regulated by the SWRCB. Examples include, but are not limited to: outflow, river flows, temperature, exports, diversions, fish survival indices, salinity, dissolved oxygen, and barrier The SWRCB solicits location and operation. recommendations from the participants on alternative fish and wildlife standards that provide both a comprehensive package of protection and a reasonable level of protection, considering the competing demands for water from the Bay-Delta Estuary. The SWRCB also intends to recommend appropriate action by other agencies on factors that contribute to the decline of fish and wildlife resources in the Bay-Delta Estuary but are beyond either SWRCB regulatory control or the scope Suggestions regarding recomof this review. mendations to other agencies are solicited.

# 2. How should the economic and social effects of alternative standards be determined?

Standards for the Bay-Delta Estuary have the potential to affect a large portion of the State. California Water Code Section 13241 requires that economic factors be

considered when the SWRCB establishes water quality objectives.

The SWRCB requests that workshop participants who intend to undertake an economic analysis of a set of alternative standards identify their intentions at the workshop. Additionally, the SWRCB requests that any economic analysis from the participants clearly identifies the following elements.

- a) Water supply impacts of alternative standards.
- b) The economic impacts resulting from these water supply impacts.
- e) Exactly how economic impacts are defined or determined.
- c) Assumptions regarding water transfers.
- d) Assumptions regarding the substitution of groundwater for Delta water.

The SWRCB requests recommendations from participants on methods to be used in the SWRCB's analysis of economic and social effects. The SWRCB is particularly interested in the following issues.

- Methods to estimate the effect of reduction in Delta water deliveries on irrigated acreage and cropping patterns.
- b) Methods to estimate the extent of water transfers likely to occur after reductions in Delta water deliveries.
- c) Assumptions on the duration of unemployment following job losses occurring as a result of changes in cropping patterns or reductions in irrigated acreage.
- d) Methods to estimate the amount of water likely to be transferred after reductions in Delta water deliveries.
- e) Methods of identifying other effects of changes in water supply.
- 3. Should the SWRCB request the CVP and SWP to implement portions of the draft standards prior to adoption of a water rights decision?

After completion of this review of Bay-Delta Estuary water quality objectives, the SWRCB will initiate a water right proceeding in order to allocate responsibility to meet the standards among the water right holders in the Central Valley and to establish terms and conditions in water right permits. This

proceeding could take two years to complete, and the standards may not be achieved during this interim period. The SWRCB requests recommendations from the participants on the advisability of requesting the CVP and SWP to implement portions of the standards until such time as a water rights decision is adopted.

#### **WORKSHOP PROCEDURES**

The workshop will be informal, but a court reporter will be present to provide an accurate record of the proceedings. There will be no sworn testimony or cross examination of participants, but the SWRCB and its staff may ask clarifying questions.

Participants are requested to provide 20 copies of their comments and recommendations either prior to or at the time of the workshop for the use of the SWRCB and its staff. Additional copies for participants of the workshop should also be provided. Participants will be asked to orally summarize their comments and recommendations. Time limits of less than 20 minutes will likely be imposed on oral presentations by each participant. Participants with similar interests are requested to make joint presentations.

The SWRCB and its staff may consult with and request information from participants and other interested parties between the date of this notice and the release of the draft plan.

#### INFORMATION REGARDING WORKSHOP

Questions concerning this notice may be directed to Thomas R. Howard, Chief, Bay-Delta Unit, at (916) 657-1873 or Barbara J. Leidigh, Senior Staff Counsel, at (916) 657-2102.

#### PARKING AND ACCESSIBILITY

The attached map shows the location of the workshop and available parking. This site is accessible to persons with disabilities.

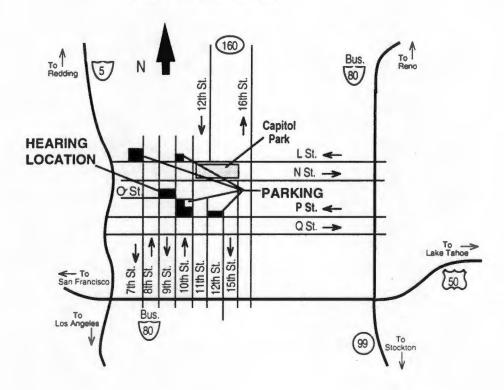
Maureen Marché

Administrative Assistant to the Board

June 14, 1994

The Resources Building 1416 Ninth Street Sacramento, CA 95814

Hearing Location First Floor, Auditorium



Admin Lac

# DEPARTMENT OF WATER RESOURCES

1416 NINTH STREET, P.O. BOX 942836 SACRAMENTO, CA 94236-0001 (916) 653-5791



July 1, 1994

Mr. Bruce Herbold U. S. Environmental Protection Agency Region IX 75 Hawthorne Street San Francisco, California 94105-3901

Dear Mr. Herbold:

In your letter dated June 10, 1994, you requested the Department of Water Resources perform model simulation studies using the monthly simulation model DWRSIM. The attached summary report identifies studies and lists assumptions for the eleven studies performed to carry out water supply impact analysis. Table I in the report summarizes water supply impacts of all requested studies.

The water supply impacts of all the standards analyzed are measured by a comparison with a base study using D-1485 standards for controlling Delta project operations. In order to facilitate understanding of study results, water supply impacts of EPA Study 2 (D-1485+EPA+1968 LOD) are discussed here. This study models X2 standards corresponding to a 1968 level of development and proposed salmon protection measures as discussed in the attached report. Water supply impacts in this study average 1,104 TAF/year during the critical dry period and 460 TAF/year as a longterm average. However, single year impacts will range between 0 and 1,700 TAF/year. In addition, average annual carryover storage in the Sacramento Basin was reduced by about 490 TAF/year with a maximum single year reduction of 1,570 TAF. As discussed in the assumptions, the pulse flow requirement at Vernalis was shared between the Stanislaus River and Tuolumne and Merced River systems per the sharing ratio proposed in draft D-1630. The Tuolumne and Merced River system diversions would be reduced by about TAF/year on an average to provide the additional share of flows to meet required pulse flows at Vernalis. New Melones reservoir carryover storage is reduced an average of 42 TAF/year to meet the Stanislaus River share of pulse flows. Note that water supply impacts presented in the Table I include the additional flows

Mr. Bruce Herbold July 1, 1994 Page Two

provided by the Tuolumne and Merced River system but do not include potential water supply impacts due to ESA "take limits".

If you would like additional information or have any questions regarding the study results, please call me at (916) 653-5924 or Sushil Arora of my staff at (916) 653-7921.

Sincerely,

George Barnes, Chief

Modeling Support Branch

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Division of Planning

Enclosure

# PRELIMINARY RESULTS OF OPERATION STUDIES ASSESSING WATER SUPPLY IMPACTS OF STUDIES REQUESTED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

#### Base Study 1 D-1485

- Meet all D-1485 criteria
- Delta Export Demands 6.0 MAF/year (SWP = 2.9 MAF/year, CVP = 3.1 MAF/year)
- See Appendix I for more detailed description of assumptions

### Base Study 2 D-1485 + NMFS

- D-1485 criteria plus NMFS Winter-Run chinook criteria
- See Appendix II for more detailed description of assumptions

#### EPA Study ·1 D-1485 + EPA 1955 LOD

- D-1485 criteria plus EPA alternative Delta standards as follows:
  - 1. An Estuarine Standard of Two Parts Per Thousand Bottom Salinity (X2)
    - As required, two parts per thousand bottom salinity (called X2) is maintained at three locations (i.e., Roe Island, Chipps Island and Confluence) for the period of February 1 through June 30. For the Chipps Island and Roe Island standards, the maximum flow requirement in meeting X2 was limited to 11,400 and 29,200 cfs, respectively. However, the cfs limit does not apply to Confluence where compliance with the X2 standard is required. Bruce Herbold of the Environmental Protection Agency provided monthly X2 standards based on a regression equation which uses preceding month's, unimpaired flow and the level of development as the variables. in Appendix III shows the fraction of month at Roe Island and Chipps Island for which standard must be met corresponding to a 1955 level of

development (LOD). To meet the Roe Island standard during any month, a storm event during preceding month must have pushed X2 line downstream of 66.3 km position. Note the model uses X2 and outflow relationship developed by Kimmerer and Monismith.

# 2. <u>Criteria Modeled For Salmon</u> Survival

- Close the Delta Cross Channel from April through June of all year types.
- Total Delta exports are restricted to 1,500 cfs during the four week period of April 15 May 15. Total exports are also limited to 4,000 cfs during remaining period of April through June. (Note: allowable exports were shared 50/50 between the CVP and SWP.)
- A San Joaquin River pulse flow at Vernalis is maintained for the 4-week period from April 15 through May 15 as follows:

Year Type 60-20-20	Flow (cfs)			
Wet	10,000			
Above Normal	8,000			
Below Normal	6,000			
Dry	4,000			
Critical	2,000			

These required flows are shared among upstream river systems using the degree of responsibility criteria developed in SWRCB's Draft D-1630 Decision.

# EPA Study 2 D-1485 + EPA + 1968 LOD

This study meets all the criteria for D-1485 plus EPA X2 standard based on 1968 level of development and salmon protection measures as discussed under EPA Study 1. Requirements for Chipps and Roe standards at 1968 level of development are presented in Table 2 in Appendix III.

# EPA Study 2a D-1485 + EPA 1968 LOD With Alt. Salmon Measures

- This study meets all the criteria for EPA Study 2; except that minimum flow at Vernalis for four weeks3 (April 15-May 15) during critical years is set at 4,000 cfs.

# EPA Study 2b D-1485 + EPA 1968 LOD + NMFS

 This study meets all the criteria for EPA Study 2, plus NMFS's Winter-run Chinook criteria as discussed in Appendix II.

# EPA Study 2c D-1485 + EPA 1968 LOD Without Roe Standard

 This study meets all the criteria for EPA Study 2, except the X2 requirement at Roe Island has been dropped.

# EPA Study 3 D-1485 + EPA 1968 LOD Without Salmon Measures

 This study meets all the criteria for EPA Study 2, except that Salmon smolt protection requirements are dropped.

#### EPA Study 4 D-1485 + EPA 1975 LOD

This study meets all the criteria for D-1485 plus EPA X2 standards based on 1975 level of development and salmon protection measures as discussed under EPA Study 1. Requirements for Chipps and Roe standards at 1975 level of development are presented in Table 3 in Appendix III.

# EPA Study 5 D-1485 + EPA 1975 LOD Without Roe Standard

 This study meets all the criteria for EPA Study 4, except the X2 requirement at Roe Island has been dropped.

# EPA Study 6 D-1485 + EPA Salmon Protection Measures

 This study meets all the criteria for D-1485 plus salmon protection measures as discussed under EPA Study 1. The X2 standard is not modeled.

TABLE 1
SUMMARY OF COMPARATIVE WATER SUPPLY IMPACTS RELATIVE TO D-1485
(1000'S AF/Year)

STUDY	Critical Dry Period Average (May 1928 - October 1934)	71-Year Average (1922 - 1992)	Average Annual Carryover Storage Sacramento Basin	Average Annual Carryover Storage New Melones	
NMFS	1,4 -618	-148	-238	0	
EPA 1955 LOD	1,2,4	3,4 -491	-550	-42	
EPA 1968 LOD	-1104	3,4 -459	-491	-42	
EPA 1968 LOD With Alt. Salmon	-1108 1,2,4	-448	-503	-59	
EPA 1968 LOD +NMFS	-1295	-595	-514	-42	
EPA 1968 LOD Without Roe Standards	-1049	-443	-467	-42	
EPA 1968 LOD Without Salmon Measures	-946	-159	-222	0	
EPA 1975 LOD	1,2,4	-442 3,4	-431	-42	
EPA 1975 LOD Without Roe Standards	1,2,4	-427	-421	-42	
EPA Salmon protection Measures	1,2,4	-309	-384	-42	

<sup>1.</sup>Includes adjustments due to upstream net Storage used.

<sup>2.</sup>Includes adjustments due to upstream net Storage used and additional flows from Tuolumne and Merced River system to meet Vernalis pulse flows.

<sup>3.</sup>Includes adjustments due to additional flows from Tuolumne and Merced River system to meet Vernalis pulse flows.

<sup>4</sup> Does not include potential water suppy impact for "Take Limis."

#### APPENDIX I

# D-1485 (Base) Study Assumptions

- \* New 1995 level hydrology and upstream depletions, based on Department of Water Resources Bulletin 160-93 land use projections (71 years: 1922 -1992).
- \* Minimum Delta outflow requirements are maintained to satisfy State Water Resources Control Board Decision D-1485, assuming Interim Suisun Marsh criteria.
- \* State Water Project Banks Pumping Plant average monthly capacity with 4 new pumps is 6,680 cfs (or 8,500 cfs in some winter months) in accordance with the United States Corps of Engineers permit criteria. Pumping is limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally, SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish & Game).
- \* Central Valley Project/State Water Project sharing of responsibility for the coordinated operation of the two projects is maintained per the Coordinated Operation Agreement; with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP, and unstored flow for storage and export split 55 percent CVP/45 percent SWP.
- \* Wheeling of CVP water through SWP facilities to San Luis Reservoir is permitted, as needed to offset the CVP Tracy Pumping Plant's compliance with D-1485 criteria in May and June. These studies assume that SWP pumping capacity will be made available so that CVP wheeling will be completed in October and November of each year. Additionally, 72 TAF/year of CVP water is wheeled to meet projected Cross Valley Canal demands when unused capacity is available to SWP Banks Pumping Plant.
- \* New Trinity River minimum fish flows below Lewiston Dam are maintained at 340 TAF/year for all years, based on the May, 1991 letter agreement between the USBR and the U. S. Fish and Wildlife Service.

- \* Sacramento River minimum fishery flows below Keswick Dam are maintained per the agreement between U. S. Bureau of Reclamation and California Department of Fish and Game (as revised October, 1981). These flows range from 2,300 to 3,900 cfs, depending on the time of year per the USBR's Shasta criteria.
- \* Sacramento River navigation control point (NCP) flows are maintained at 4,000 cfs for all twelve months of all years type.
- \* Folsom Reservoir storage capacity has been reduced from 1,010 TAF down to 974 TAF due to sediment accumulation, as calculated from a recent 1992 reservoir capacity survey. Additionally, the flood control reservation has been revised to incorporate the flexible criteria, per the December, 1993 USCE report "Folsom Dam and Lake Operation Evaluation". This flood control criteria incorporates use of available reservoir storage space in upstream reservoirs, such that the maximum Folsom Lake flood control reservation will vary from 400 TAF to 670 TAF.
- Lower American River minimum fish and recreation flows are variable, and are determined based on the available storage in Folsom Lake per USBR operation criteria. Minimum flows can range from 250 cfs (when storage is less than 100 TAF) up to 2,000 cfs (when storage is above 600 TAF). Minimum flows of 1,250 to 1,500 cfs are normally maintained, during periods of average water storage conditions in Folsom Reservoir.
- \* Stanislaus River minimum fish flows below New Melones Reservoir range from 98 TAF/year up to 302 TAF/year, according to the interim agreement (dated June, 1987) between the USBR and the California Department of Fish & Game. The actual minimum fish flow for each year is determined based on the water supply available for that year.
- \* San Joaquin River water quality standards at Vernalis are maintained per SWRCB Decision 1422 (500 ppm TDS on an average basis). Additional water releases from New Melones Reservoir are made when necessary to maintain these standards at Vernalis, up to a maximum amount of 70 TAF/year.

#### 1995 level CVP demands are as follows:

Contra Costa Canal	=	118	TAF/year
DMC and Exchange	=	1,555	
CVP San Luis Unit	=	1,118	
San Felipe Unit	=	136	
Cross Valley Canal	. =	122	
Total CVP Delta Exports	=	3,049	TAF/year
Folsom South Canal	=	65	TAF/year

Note that certain wet years in the San Joaquin River Basin when "James" bypass flows are available in the Mendota Pool, Tracy export demand will be reduced significantly.

\*SWP Contractor requests are set to represent present level deliveries, and are met to the extent possible each year based on available supply.

No. Bay Aqueduct	38 TAF/year
So. Bay Aqueduct	183
SWP Dos Amigos demands	2,679
Recreation and Losses	64
Total Demands	2.964 TAF/vear

\*When needed, SWP Agricultural and M&I deficiencies are imposed per the standard Contract criteria, with deficiencies calculated from 1994 Table A Entitlements, summarized as follows:

#### 1994 Table A Entitlement

Agricultural entitlements	1,220 TAF/year
M & I entitlements	2,851
Recreation & Losses	64
Total Entitlements	4,135 TAF/year

#### APPENDIX II

#### AMFS' Winter-Run Chinook Salmon Criteria

On February 12, 1993, the National Marine Fisheries Service issued a biological opinion for operation of the CVP and SWP for winter-run chinook salmon. Not all of the 13 criteria required in NMFS's "Reasonable and Prudent Alternative" are modeled in DWRSIM. Those items that are included in DWRSIM (using the NMFS numbering sequence) are as follows:

- (2) The end-of-water-year (September 30) carryover storage in Shasta Reservoir is maintained at 1.9 MAF in normal years. However, in some critical years, it is not possible to maintain a minimum carryover storage of 1.9 MAF.
- (3) A minimum flow of 3,250 cfs from Keswick Dam to the Sacramento River is maintained from October 1 through March 31 of all water year types.
- (7) The Delta Cross Channel Gates are maintained in the closed position from February 1 through April 30 of all water year types.
- (9) The QWEST reverse flow is maintained at greater than or equal to 0 cfs from February 1 through April 30 of all water year types.
- (10) The QWEST reverse flow is maintained at greater than -2,000 cfs from November 1 through January 31 of all water year types. This standard is not dropped whenever Mallard Slough water quality is better than or equal to 3.0 EC.

#### Note:

- The most significant NMFS criteria not modeled is the "take limit" at the SWP and CVP export pumps in the Delta, which has required significant reductions in exports this year even though all water quality and flow criteria was being met.
- The requirement to meet QWEST in these studies was shared by the CVP and SWP by allowing equal export capacity between the two projects, not according to existing COA percentages. This assumption affects the relative split of impacts between the CVP and SWP and reservoir storage levels. However, in this report, only the combined water supply impacts of the CVP and SWP are shown.

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1955 LEVEL OF DEVELOPMENT

			CHIPPS	ISLAND				ROE	ISLAND		
YEAR		FEB	MAR	APR	MAY	JUN	FEB	MAR	APR	MAY	JUN
1922		1.00	1.00	0.98	1.00	1.00	0.48	0.80	0.49	0.71	0.00
1923		1.00	1.00	0.67	1.00	0.93	0.72		0.14	.6 .59	0.00
1924 1925		1.00	1.00	0.01	0.00	0.00	0.19	0.30	0.01	0.00	0.00
1925		1.00	1.00	0.93	1.00	0.94	0.41	0.96	0.39	0.76	0.00
1927		1.00	1.00	1.00	1.00	0.98	0.81	0.98	0.80	0.75	0.00
1928		1.00	1.00	1.00	1.00	0.67	0.61	0.64	0.96	0.73	0.00
1929		1.00	1.00	0.42	0.03	0.23	0.23	0.28	0.98	0.73	0.00
1930		1.00	1.00	0.99	0.96	0.11	0.62	0.60	0.62	0.22	0.00
1931		1.00	1.00	0.31	0.00	0.00	0.34	0.12	0.06	0.00	0.00
1932		1.00	1.00	0.98	0.98	0.98	0.59	0.60	0.52	0.26	0.00
1933		1.00	1.00	0.89	0.31	0.15	0.28	0.06	0.28	0.04	0.00
1934		1.00	1.00	0.90	0.03	0.00	0.64	0.50	0.28	0.01	0.00
1935		1.00	1.00	0.95	1.00	0.99	0.75	0.49	0.37	0.99	0.00
1936		1.00	1.00	0.99	1.00	0.94	0.90	0.96	0.62	0.76	0.00
1937		1.00	1.00	1.00	1.00	1.00	0.18	0.75	0.75	0.75	0.00
1938		1.00	1.00	1.00	1.00	1.00	0.74	0.96	0.99	0.98	0.00
1939		1.00	1.00	0.90	0.75	0.00	0.33	0.14	0.28	0.09	0.00
1940		1.00	1.00	1.00	1.00	0.95	0.93	0.97	0.97	0.92	0.00
1941		1.00	1.00	1.00	1.00	1.00	0.94	0.96	0.92	0.92	0.00
1942		1.00	1.00	0.96	1.00	0.99	0.94	0.96	0.41	0.92	0.00
1943		1.00	1.00	1.00	1.00	0.92	0.95	0.83	0.95	0.86	0.00
1944		1.00	1.00	0.91	0.20	0.84	0.33	0.44	0.29	0.03	0.00
1945		1.00	1.00	0.95	0.98	0.95	0.48	0.93.	0.39	0.30	0.00
1946		1.00	1.00	0.97	1.00	0.93	0.86	0.37	0.44	0.62	0.00
1947 1948		1.00	1.00	0.98	1.00	0.99	0.75	0.10	0.15	0.08	0.00
1949		1.00	1.00	1.00	1.00	0.86	0.18	0.18	0.76	0.53	0.00
1950	-	1.00	1.00	0.98	1.00	0.94	0.74	0.79	0.51	0.73	0.00
1951		1.00	1.00	0.99	0.98	0.75	0.91	0.90	0.58	0.30	0.00
1952		1.00	1.00	1.00	1.00	1.00	0.91	0.93	0.82	0.99	0.00
1953		1.00	1.00	C. 94	1.00	0.86	0.96	0.47	0.35	0.52	0.00
1954	`	1.00	1.00	1.00	1.00	0.81	0.80	0.83	0.82	0.91	0.00
1955		1.00	1.00	0.40	0.32	0.79	0.52	0.20	0.08	0.04	0.00
1956		1.00	1.00	0.99	1.00	1.00	0.98	0.91	0.70	0.65	0.00
1957		1.00	1.00	1.00	0.85	0.96	0.33	0.80	0.78	0.12	0.00
1958		1.00	1.00	1.00	1.00	1.00	0.83	0.99	0.92	0.98	0.00
1959		1.00	1.00	0.92	0.77	0.01	0.81	0.78	0.31	0.10	0.00
1960		1.00	1.00	1.00	0.92	0.16	0.39	0.87	0.74	0.16	0.00
1961		1.00	1.00	0.91	0.39	0.07	0.37	0.69	0.29	0.05	0.00
1962		1.00	1.00	0.97	1.00	0.75	0.33	0.93	0.48	0.78	0.00
1963		1.00	1.00	0.94	1.00	1.00	0.71	0.95	0.36	0.98	0.00
1964		1.00	1.00	0.25	0.25	0.19	0.66	0.23	0.05	0.03	0.00
1965		1.00	1.00	0.92	1.00	0.95	0.97	0.73	0.31	0.93	0.00
1966		1.00	1.00	0.98	1.00	0.24	0.74	0.49	0.53	0.56	0.00
1967		1.00		1.00	1.00	0.06	0.65	0.78	0.54	0.78	0.00
1968 1969		1.00	1.00	1.00	1.00	1.00	0.98	0.95	0.77	0.97	0.00
1970		1.00	1.00	1.00	0.14	0.45	0.99	0.85	0.72	0.02	0.00
1971		1.00	1.00	1.00	1.00	0.98	0.89	0.60	0.83	0.60	0.00
1972		1.00	1.00	1.00	0.93	0.32	0.62	0.56	0.76	0.17	0.00
1973		1.00	1.00	1.00	1.00	0.99	0.94	0.91	0.75	0.44	0.00
1974		1.00	1.00	1.00	1.00	0.99	0.98	0.68	0.97	0.95	0.00
1975		1.00	1.00	1.00	0.99	1.00	0.45	0.84	0.92	0.34	0.00
1976		1.00	1.00	0.47	0.00	0.00	0.24	0.16	0.09	0.00	0.00
1977		1.00	1.00	0.00	0.00	0.00	0.15	0.04	0.00	0.00	0.00
1978		1.00	1.00	1.00	1.00	0.99	0.97	0.90	0.95	0.89	0.00
1979		1.00	1.00	0.99	0.97	0.99	0.63	0.69	0.66	0.23	0.00
1980		1.00	1.00	1.00	1.00	0.93	0.98	0.97	0.82	0.45	0.00
1981		1.00	1.00	0.98	0.82	0.05	0.67	0.57	0.51	0.11	0.00
1982		1.00	1.00	1.00	1.00	1.00	0.91	0.97	0.92	1.00	0.00
1983		1.00	1.00	1.00	1.00	1.00	0.94	0.98	1.00	0.94	0.00
1984		1.00	1.00	0.99	0.92	0.92	0.88	0.73	0.71	0.17	0.00
1985		1.00	1.00	0.74	0.98	0.06	0.36	0.32	0.17	0.29	0.00
1986		1.00	1.00	1.00	1.00	0.91	0.85	1.00	0.98	0.49	0.00
1987		1.00	1.00	0.98	0.07	0.00	0.32	0.47	0.54	0.02	0.00
1988		1.00	1.00	0.38	0.01	0.00	0.74	0.22	0.08	0.01	0.00
1989		1.00	1.00	1.00	1.00	0.08	0.37	0.22	0.97	0.68	0.00
1990		1.00	1.00	0.87	0.10	0.01	0.57	0.17	0.25	0.02	0.00
1991		1.00	1.00	0.99	0.28	0.16	0.09	0.03	0.32	0.04	0.00
1992		1.00	1.00	0.93	0.00	0.00	0.21	0.76	0.32	0.00	0.00

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1968 LEVEL OF DEVELOPMENT

	CHIPPS ISLAND					ROE ISLAND					
YEAR	FEB	MAR	APR	MAY	JUN	FEB	MAR	APR	MAY	JUN	
1922	1.00	1.00	0.95	0.99	1.00	0.52	0.69	0.27	0.43	0.00	
1923	1.00	1.00	0.49	0.98	0.67	0.75	0.20	0.06	0.31	0.00	
1924	1.00	1.00	0.00	0.00	0.00	0.22	0.19	0.00	0.00	0.00	
1925	1.00	1.00	0.91	1.00	0.70	0.45	0.93	0.20	0.50	0.00	
1926	1.00	1.00	0.70	1.00	0.01	0.35	0.79	0.10	0.48	0.00	
1927	1.00	1.00	1.00	1.00	0.91	0.83	0.96	0.61	0.82	0.00	
1928	1.00	1.00	1.00	1.00	0.23	0.83	0.49	0.91	0.46	0.00	
1929	1.00	1.00	0.26	0.00	0.04	0.25	0.18	0.03	0.00	0.00	
1930 1931	1.00	1.00	0.98	0.68	0.02	0.65	0.45	0.39	0.08	0.00	
1932	1.00	1.00		0.77	0.88	0.37	0.45	0.30	0.10	0.00	
1933	1.00	0.02	0.81	0.04	0.03	0.62 0.31 0.67	0.03	0.13	0.01	0.00	
1934	1.00	1.00	0.81	0.00	0.00	0.67	0.36	0.13	0.00	0.00	
1935	1.00	1.00	0.90	1.00	0.96	0.77	0.35	0.19	0.96	0.00	
1936	1.00	1.00	0.98	1.00	0.71	0.91	0.93	0.39	0.50	0.00	
1937	1.00	1.00	0.99	1.00	0.98	0.21 0.77 0.36 0.94	0.62	0.55	0.47	0.00	
1938	1.00	1.00		1.00	1.00	0.77	0.94	0.97	0.95	0.00	
1939	1.00	0.84	0.81	0.20	0.00	0.36	0.08	0.13	0.03	0.00	
1940	1.00	1.00	1.00	1.00	0.74	0.94	0.95	0.93	0.77	0.00	
1941 1942	1.00	1.00	1.00	1.00	0.99	0.95 0.95 0.96	0.93	0.83	0.77	0.00	
1942	1.00	1.00	1.00	1.00	0.97	0.95	0.73	0.88	0.78	0.00	
1944	1.00	1.00	0.83	0.02	0.45	0.36	0.30	0.14	0.01	0.00	
1945	1.00	1.00	0.91	0.84	0.76	0.52	0.88	0.20	0.12	0.00	
1946	1.00	1.00	0.93	0.99	0.69	0.87	0.25	0.24	0.33	0.00	
1947	1.00	1.00	0.96	0.16	0.01	0.27	0.35	0.31	0.03	0.00	
1948	1.00	0.33	0.54	1.00	0.94	0.78	0.06	0.07	0.69	0.00	
1949	1.00	0.97	0.99	0.97	0.49	0.20	0.11	0.56	0.26	- 0.00	
1950	1.00	1.00	0.96	1.00	0.71	0.76	0.67	0.29	0.46	0.00	
1951	1.00	1.00	0.97	0.83	0.32	0.92	0.83	0.35	0.11	0.00	
1952	1.00	1.00	1.00	1.00	1.00	0.92	0.88	0.65	0.97	0.00	
1.953	1.00	1.00	0.88	0.97	0.48	0.97	0.33	0.17	0.25	,0.00	
1954 1955	1.00	1.00	1.00	1.00	0.40	0.83	0.73	0.65	0.76	0.00	
1956	1.00	1.00	0.25	0.99	0.99	0.98	0.12	0.48	0.36	0.00	
1957	1.00	1.00	0.99	0.32	0.78			0.58	0.04	0.00	
1958	1.00	1.00	1.00	1.00	1.00	0.37 0.85	0.98	0.83	0.95	0.00	
1959	1.00	1.00	0.85	0.22	0.00			0.15	0.03	0.00	
1960	1.00	1.00	0.99	0.50	0:03	0.83	0.78	0.53	0.06	0.00	
1961	1.00	1.00	0.83	0.05	0.01	0.40 0.36 0.74	0.56	0.14	0.01	0.00	
1962	1.00	1.00	0.95	1.00	0.31	0.36	0.88	0.27	0.52	0.00	
1963	1.00	1.00	0.89	1.00	0.98	0.74	0.91	0.18	0.92	0.0.0	
1964	1.00	0.99	0.14	0.03	0.03	0.70	0.14	0.02	0.01	0.00	
1965 1966	1.00	1.00	0.84	1.00	0.76	0.97	0.59	0.15	0.80	0.00	
1967	1.00	1.00	1.00	1.00	1.00	0.92	0.66	0.74	0.49	0.00	
1968					0.01	0.68	0.85				
1969	1.00	1.00	0.99	1.00	1.00	0.99	0.92	0.57	0.91	0.00	
1970	1.00	1.00	0.99	0.01	0.11	0.99	0.76	0.50	0.01	0.00	
1971	1.00	1.00	1.00	0.99	0.89	0.90	0.45	0.66.	0.31	0.00	
1972	1.00	1.00	0.99	0.53	0.07	0.65	0.41	0.55	0.06	0.00	
1973	1.00	1.00	0.99	0.95	0.97	0.94	0.85	0.55	0.19	0.00	
1974	1.00	1.00	1.00	1.00	0.96	0.98	0.54	0.93	0.86	0.00	
1975	1.00	1.00	1.00	0.88	0.99	0.49	0.75	0.82	0.14	0.00	
1976	1.00	0.94	0.30	0.00	0.00	0.27	0.10	0.04	0.00	0.00	
1977	1.00	0.00	0.00	0.00	0.00	0.17	0.02	0.00	0.00	0.00	
1978 1979	1.00	1.00	1.00	1.00	0.96	0.66	0.83	0.89	0.09	0.00	
1980	1.00	1.00	1.00	0.72	0.68	0.98	0.95	0.64	0.20	0.00	
1981	1.00	1.00	0.96	0.27	0.01	0.70	0.42	0.29	0.04	0.00	
1982	1.00	1.00	1.00	1.00	0.99	0.93	0.95	0.83	0.99	0.00	
1983	1.00	1.00	1.00	1.00	1.00	0.95	0.96	0.99	0.83	0.00	
1984	1.00	1.00	0.99	0.51	0.64	0.89	0.60	0.49	0.06	0.00	
1985	1.00	1.00	0.58	0.82	0.01	0.39	0.21	0.07	0.11	0.00	
1986	1.00	1.00	1.00	0.97	0.61	0.87	0.99	0.96	0.23	0.00	
1987	1.00	1.00	0.97	0.01	0.00	0.36	0.33	0.32	0.01	0.00	
1988	1.00	0.99	0.23	0.00	0.00	0.76	0.14	0.03	0.00	0.00	
1989	1.00	0.99	1.00	0.99	0.01	0.40	0.13	0.93	0.39	0.00	
1990 1991	1.00	0.95	0.77	0.01	0.00	0.60	0.10	0.12	0.01	0.00	
1992	1.00	1.00	0.86	0.14	0.00	0.24	0.64	0.16	0.02	0.00	
	2.00										

TABLE 3

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1975 LEVEL OF DEVELOPMENT

	CHIPPS ISLAND					ROE ISLAND				
1969 1970 1971 1972 1973 1974 1975 1976	1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	MAR 1.00 0.05 0.03 1.00 1.00 1.00 1.00 0.99 0.02 0.98 0.00 1	APR 0.930.00 0.87 0.00 0.87 0.99 1.00 0.79 0.13 0.74 0.86 0.97 0.09 1.00 0.77 0.87 0.91 0.07 0.99 1.00 0.99 0.99 0.99 0.99 0.99 0.99	MAY 0.98 0.99 0.99 0.99 0.99 0.99 0.99 0.99	1.00 0.04 0.74 0.03 0.91 0.90 0.97 0.00	FEB 0.54 0.76 0.23 0.47 0.36 0.84 0.66 0.27 0.67 0.39 0.69 0.79 0.92 0.78 0.94 0.95 0.95 0.96 0.38 0.54 0.88 0.79 0.21 0.78 0.93 0.97 0.88 0.98 0.79 0.91 0.78 0.98 0.38 0.86 0.84 0.45 0.45 0.77 0.71 0.77 0.78 0.97 0.71 0.79 0.99 0.91 0.67 0.99 0.99 0.91 0.67 0.98	MAR 0.16 0.14 0.73 0.94 0.13 0.05 0.09 0.28 0.09 0.28 0.99 0.29 0.99 0.28 0.99 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28	APR 0.19 0.04 0.00 0.13 0.06 0.49 0.86 0.02 0.28 0.02 0.28 0.02 0.08 0.13 0.42 0.94 0.09 0.87 0.15 0.82 0.09 0.15 0.01 0.16 0.21 0.04 0.25 0.36 0.11 0.02 0.36 0.11 0.04 0.10 0.10 0.10 0.11 0.63	MAY 0.28 0.19 0.00 0.33 0.71 0.31 0.00 0.05 0.01 0.00 0.05 0.01 0.02 0.04 0.05 0.00 0.05 0.00 0.01 0.05 0.01 0.05 0.01 0.02 0.03 0	JUN 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.
1975 1976	1.00 1.00	1.00	1.00 0.23	0.66	0.97 0.00	0.51 0.28	0.68 0.07 0.01	0.73 0.02 0.00	0.08 0.00 0.00	0.00 0.00 0.00



DEPARTMENT OF WATER RESOURCES

1416 NINTH STREET, P.O. BOX 942836 SACRAMENTO, CA 94236-0001 (916) 653-5791



July 1, 1994

Mr. Bruce Herbold U. S. Environmental Protection Agency Region IX 75 Hawthorne Street San Francisco, California 94105-3901

Dear Mr. Herbold:

In your letter dated June 10, 1994, you requested the Department of Water Resources perform model simulation studies using the monthly simulation model DWRSIM. The attached summary report identifies studies and lists assumptions for the eleven studies performed to carry out water supply impact analysis. Table I in the report summarizes water supply impacts of all requested studies.

The water supply impacts of all the standards analyzed are measured by a comparison with a base study using D-1485 standards for controlling Delta project operations. In order to facilitate understanding of study results, water supply impacts of EPA Study 2 (D-1485+EPA+1968 LOD) are discussed here. This study models X2 standards corresponding to a 1968 level of development and proposed salmon protection measures as discussed in the attached report. Water supply impacts in this study average 1,104 TAF/year during the critical dry period and 460 TAF/year as a longterm average. However, single year impacts will range between 0 and 1,700 TAF/year. In addition, average annual carryover storage in the Sacramento Basin was reduced by about 490 TAF/year with a maximum single year reduction of 1,570 TAF. As discussed in the assumptions, the pulse flow requirement at Vernalis was shared between the Stanislaus River and Tuolumne and Merced River systems per the sharing ratio proposed in draft D-1630. The Tuolumne and Merced River system diversions would be reduced by about TAF/year on an average to provide the additional share of flows to meet required pulse flows at Vernalis. New Melones reservoir carryover storage is reduced an average of 42 TAF/year to meet the Stanislaus River share of pulse flows. Note that water supply impacts presented in the Table I include the additional flows

Mr. Bruce Herbold July 1, 1994 Page Two

provided by the Tuolumne and Merced River system but do not include potential water supply impacts due to ESA "take limits".

If you would like additional information or have any questions regarding the study results, please call me at (916) 653-5924 or Sushil Arora of my staff at (916) 653-7921.

Sincerely,

George Barnes, Chief Modeling Support Branch

Division of Planning

Enclosure

# PRELIMINARY RESULTS OF OPERATION STUDIES ASSESSING WATER SUPPLY IMPACTS OF STUDIES REQUESTED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

#### Base Study 1 D-1485

- Meet all D-1485 criteria
- Delta Export Demands 6.0 MAF/year (SWP = 2.9
   MAF/year, CVP = 3.1 MAF/year)
- See Appendix I for more detailed description of assumptions

#### Base Study 2 D-1485 + NMFS

- D-1485 criteria plus NMFS Winter-Run chinook criteria
- See Appendix II for more detailed description of assumptions

#### EPA Study 1 D-1485 + EPA 1955 LOD

- D-1485 criteria plus EPA alternative Delta standards as follows:
  - 1. An Estuarine Standard of Two Parts Per Thousand Bottom Salinity (X2)
  - As required, two parts per thousand bottom salinity (called X2) is maintained at three locations (i.e., Roe Island, Chipps Island and Confluence) for the period of February 1 through June 30. For the Chipps Island and Roe Island standards, the maximum flow requirement in meeting X2 was limited to 11,400 and 29,200 cfs, respectively. However, the cfs limit does not apply to Confluence where compliance with the X2 standard is required. Bruce Herbold of the Environmental Protection Agency provided monthly X2 standards based on a regression equation which uses preceding month's, unimpaired flow and the level of development as the variables. in Appendix III shows the fraction of month at Roe Island and Chipps Island for which standard must be met corresponding to a 1955 level of

development (LOD). To meet the Roe Island standard during any month, a storm event during preceding month must have pushed X2 line downstream of 66.3 km position. Note the model uses X2 and outflow relationship developed by Kimmerer and Monismith.

# 2. <u>Criteria Modeled For Salmon</u> Survival

- Close the Delta Cross Channel from April through June of all year types.
- Total Delta exports are restricted to 1,500 cfs during the four week period of April 15 May 15. Total exports are also limited to 4,000 cfs during remaining period of April through June. (Note: allowable exports were shared 50/50 between the CVP and SWP.)
- A San Joaquin River pulse flow at Vernalis is maintained for the 4-week period from April 15 through May 15 as follows:

Year Type 60-20-20	Flow (cfs)
Wet	10,000
Above Normal	8,000
Below Normal	6,000
Dry	4,000
Critical	2,000

These required flows are shared among upstream river systems using the degree of responsibility criteria developed in SWRCB's Draft D-1630 Decision.

# EPA Study 2 D-1485 + EPA + 1968 LOD

This study meets all the criteria for D-1485 plus EPA X2 standard based on 1968 level of development and salmon protection measures as discussed under EPA Study 1. Requirements for Chipps and Roe standards at 1968 level of development are presented in Table 2 in Appendix III.

# EPA Study 2a D-1485 + EPA 1968 LOD With Alt. Salmon Measures

- This study meets all the criteria for EPA Study 2; except that minimum flow at Vernalis for four weeks3 (April 15-May 15) during critical years is set at 4,000 cfs.

#### EPA Study 2b D-1485 + EPA 1968 LOD + NMFS

 This study meets all the criteria for EPA Study 2, plus NMFS's Winter-run Chinook criteria as discussed in Appendix II.

# EPA Study 2c D-1485 + EPA 1968 LOD Without Roe Standard

- This study meets all the criteria for EPA Study 2, except the X2 requirement at Roe Island has been dropped.

#### EPA Study 3 D-1485 + EPA 1968 LOD Without Salmon Measures

This study meets all the criteria for EPA Study 2, except that Salmon smolt protection requirements are dropped.

# EPA Study 4 D-1485 + EPA 1975 LOD

This study meets all the criteria for D-1485 plus EPA X2 standards based on 1975 level of development and salmon protection measures as discussed under EPA Study 1. Requirements for Chipps and Roe standards at 1975 level of development are presented in Table 3 in Appendix III.

# EPA Study 5 D-1485 + EPA 1975 LOD Without Roe Standard

 This study meets all the criteria for EPA Study 4, except the X2 requirement at Roe Island has been dropped.

# EPA Study 6 D-1485 + EPA Salmon Protection Measures

 This study meets all the criteria for D-1485 plus salmon protection measures as discussed under EPA Study 1. The X2 standard is not modeled.

TABLE 1
SUMMARY OF COMPARATIVE WATER SUPPLY IMPACTS RELATIVE TO D-1485
(1000'S AF/Year)

STUDY	Critical Dry Period Average (May 1928 - October 1934)	71-Year Average (1922 - 1992)	Average Annual Carryover Storage Sacramento Basin	Average Annual Carryover Storage New Melones
NM <i>P</i> S	-618	-148	-238	o <u>;</u>
EPA 1955 LOD	-1269	3,4 -491	-550	-42
EPA 1968 LOD	-11,04	3,4 -459	-491	-42
EPA 1968 LOD With Alt. Salmon	-1\08 <sup>1.2.4</sup>	-448	-503	-59
EPA 1968 LOD +NMFS	1,2,4 -1 <b>2</b> 95	-595	-514	-42
EPA 1968 LOD Without Roe Standards	-1049	3,4 -443	-467	-42
EPA 1968 LOD Without Salmon Measures	1,4 -946	-159	-222	0
EPA 1975 LOD	1,2,4 -967	-442 <sup>3,4</sup>	į, −431	-42
EPA 1975 LOD Without Roe Standards	1,2,4	-427	-421	-42
EPA Salmon protection Measures	1,2,4 -417	-309	-384	-42

<sup>1.</sup>Includes adjustments due to upstream net Storage used.

<sup>2.</sup>includes adjustments due to upstream net Storage used and additional flows from Tuolumne and Merced River system to meet Vernalis pulse flows.

<sup>3.</sup>includes adjustments due to additional flows from Tuolumne and Merced River system to meet Vernalis pulse flows.

<sup>4.</sup>Does not include potential water supply impact for "Take Limits."

#### APPENDIX I

#### D-1485 (Base) Study Assumptions

- \* New 1995 level hydrology and upstream depletions, based on Department of Water Resources Bulletin 160-93 land use projections (71 years: 1922 -1992).
- \* Minimum Delta outflow requirements are maintained to satisfy State Water Resources Control Board Decision D-1485, assuming Interim Suisun Marsh criteria.
- \* State Water Project Banks Pumping Plant average monthly capacity with 4 new pumps is 6,680 cfs (or 8,500 cfs in some winter months) in accordance with the United States Corps of Engineers permit criteria. Pumping is limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally, SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish & Game).
- \* Central Valley Project/State Water Project sharing of responsibility for the coordinated operation of the two projects is maintained per the Coordinated Operation Agreement; with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP, and unstored flow for storage and export split 55 percent CVP/45 percent SWP.
- \* Wheeling of CVP water through SWP facilities to San Luis Reservoir is permitted, as needed to offset the CVP-Tracy Pumping Plant's compliance with D-1485 criteria in May and June. These studies assume that SWP pumping capacity will be made available so that CVP wheeling will be completed in October and November of each year. Additionally, 72 TAF/year of CVP water is wheeled to meet projected Cross Valley Canal demands when unused capacity is available to SWP Banks Pumping Plant.
- \* New Trinity River minimum fish flows below Lewiston Dam are maintained at 340 TAF/year for all years, based on the May, 1991 letter agreement between the USBR and the U.S. Fish and Wildlife Service.

- \* Sacramento River minimum fishery flows below Keswick Dam are maintained per the agreement between U. S. Bureau of Reclamation and California Department of Fish and Game (as revised October, 1981). These flows range from 2,300 to 3,900 cfs, depending on the time of year per the USBR's Shasta criteria.
- \* Sacramento River navigation control point (NCP) flows are maintained at 4,000 cfs for all twelve months of all years type.
- \* Folsom Reservoir storage capacity has been reduced from 1,010 TAF down to 974 TAF due to sediment accumulation, as calculated from a recent 1992 reservoir capacity survey. Additionally, the flood control reservation has been revised to incorporate the flexible criteria, per the December, 1993 USCE report "Folsom Dam and Lake Operation Evaluation". This flood control criteria incorporates use of available reservoir storage space in upstream reservoirs, such that the maximum Folsom Lake flood control reservation will vary from 400 TAF to 670 TAF.
- \* Lower American River minimum fish and recreation flows are variable, and are determined based on the available storage in Folsom Lake per USBR operation criteria. Minimum flows can range from 250 cfs (when storage is less than 100 TAF) up to 2,000 cfs (when storage is above 600 TAF). Minimum flows of 1,250 to 1,500 cfs are normally maintained, during periods of average water storage conditions in Folsom Reservoir.
- \* Stanislaus River minimum fish flows below New Melones Reservoir range from 98 TAF/year up to 302 TAF/year, according to the interim agreement (dated June, 1987) between the USBR and the California Department of Fish & Game. The actual minimum fish flow for each year is determined based on the water supply available for that year.
- \* San Joaquin River water quality standards at Vernalis are maintained per SWRCB Decision 1422 (500 ppm TDS on an average basis). Additional water releases from New Melones Reservoir are made when necessary to maintain these standards at Vernalis, up to a maximum amount of 70 TAF/year.

#### 1995 level CVP demands are as follows:

Contra Costa Canal DMC and Exchange CVP San Luis Unit San Felipe Unit Cross Valley Canal	= = = = ==	118 TAF/year 1,555 1,118 136 
Total CVP Delta Exports	=	3,049 TAF/year
Folsom South Canal	=	65 TAF/year

Note that certain wet years in the San Joaquin River Basin when "James" bypass flows are available in the Mendota Pool, Tracy export demand will be reduced significantly.

\*SWP Contractor requests are set to represent present level deliveries, and are met to the extent possible each year based on available supply.

No. Bay Aqueduct	38	TAF/year
So. Bay Aqueduct	183	
SWP Dos Amigos demands	2,679	
Recreation and Losses	64	
Total Demands	2,964	TAF/year

\*When needed, SWP Agricultural and M&I deficiencies are imposed per the standard Contract criteria, with deficiencies calculated from 1994 Table A Entitlements, summarized as follows:

#### 1994 Table A Entitlement

Agricultural entitlements	1,220 TAF/year
M & I entitlements	2,851
Recreation & Losses	64
Total Entitlements	4,135 TAF/year

#### APPENDIX II

#### NMFS' Winter-Run Chinook Salmon Criteria

On February 12, 1993, the National Marine Fisheries Service issued a biological opinion for operation of the CVP and SWP for winter-run chinook salmon. Not all of the 13 criteria required in NMFS's "Reasonable and Prudent Alternative'" are modeled in DWRSIM. Those items that are included in DWRSIM (using the NMFS numbering sequence) are as follows:

- (2) The end-of-water-year (September 30) carryover storage in Shasta Reservoir is maintained at 1.9 MAF in normal years. However, in some critical years, it is not possible to maintain a minimum carryover storage of 1.9 MAF.
- (3) A minimum flow of 3,250 cfs from Keswick Dam to the Sacramento River is maintained from October 1 through March 31 of all water year types.
- (7) The Delta Cross Channel Gates are maintained in the closed position from February 1 through April 30 of all water year types.
- (9) The QWEST reverse flow is maintained at greater than or equal to 0 cfs from February 1 through April 30 of all water year types.
- (10) The QWEST reverse flow is maintained at greater than -2,000 cfs from November 1 through January 31 of all water year types. This standard is not dropped whenever Mallard Slough water quality is better than or equal to 3.0 EC.

#### Note:

- The most significant NMFS criteria <u>not</u> modeled is the "take limit" at the SWP and CVP export pumps in the Delta, which has required significant reductions in exports this year even though all water quality and flow criteria was being met.
- The requirement to meet QWEST in these studies was shared by the CVP and SWP by allowing equal export capacity between the two projects, not according to existing COA percentages. This assumption affects the relative split of impacts between the CVP and SWP and reservoir storage levels. However, in this report, only the combined water supply impacts of the CVP and SWP are shown.

TABLE 1

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1955 LEVEL OF DEVELOPMENT

YEAR	1.01(1111)1		CHIPPS	S ISLAND				ROE	ISLAND	01 0010	
1922	VEND	FFB	MΔD	ΔDD	MΔV	ли	FFR			MAV	THIM
1924							0.48	0.80			
1925							0.72.	0.32			
1926											
1928											
1929	1927					0.98	0.81	0.98	0.80	0.94	
1930											
1931											
1932											
1934							0.59	0.60	0.52	0.26	0.00
1935											
1936											
1937											
1939	1937	1.00		1.00	1.00	1.00					
1940											
1941											
1943											
$ \begin{array}{c} 1944 \\ 1,00 \\ 1945 \\ 1.00 \\ 1.00 \\ 1.00 \\ 0.95 \\ 0.98 \\ 0.95 \\ 0.98 \\ 0.95 \\ 0.98 \\ 0.95 \\ 0.98 \\ 0.95 \\ 0.08 \\ 0.04 \\ 0.24 \\ 0.04 \\ 0.24 \\ 0.04 \\ 0.49 \\ 0.52 \\ 0.08 \\ 0.37 \\ 0.04 \\ 0.02 \\ 0.08 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.91 \\ 0.00 \\ 0.00 \\ 0.91 \\ 0.00 \\ 0.00 \\ 0.92 \\ 0.00 \\ 0.00 \\ 0.93 \\ 0.00 \\ 0.00 \\ 0.94 \\ 0.00 \\ 0.00 \\ 0.94 \\ 0.00 \\ 0.00 \\ 0.94 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.94 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.95 \\ 0.00 \\ 0$											
1945									0.95		
1946											
1948						0.93	0.86	0.37	0.44	0.62	0.00
1949							0.24				
1950											
1951											
1953	1951			0.99	0.98				0.58		
1954											
1955         1.00         1.00         0.40         0.32         0.79         0.52         0.20         0.08         0.04         0.00           1956         1.00         1.00         0.95         1.00         0.98         0.91         0.70         0.65         0.00           1958         1.00         1.00         1.00         1.00         1.00         1.00         0.00         0.92         0.98         0.00           1959         1.00         1.00         0.00         0.92         0.77         0.01         0.81         0.78         0.12         0.00           1960         1.00         1.00         0.92         0.16         0.39         0.87         0.74         0.16         0.00           1961         1.00         1.00         0.97         1.00         0.75         0.33         0.93         0.48         0.78         0.00           1962         1.00         1.00         0.97         1.00         0.75         0.33         0.93         0.48         0.98         0.00           1963         1.00         1.00         0.92         1.00         1.00         0.93         0.00           1964         1.00         1											
1956         1.00         1.00         0.99         1.00         1.00         0.98         0.91         0.70         0.65         0.00           1957         1.00         1.											
1958	1956		1.00				0.98	0.91	0.70		
1959											
1960											
1962         1.00         1.00         0.97         1.00         0.75         0.33         0.93         0.48         0.78         0.00           1963         1.00         1.00         0.94         1.00         1.00         0.71         0.95         0.36         0.98         0.00           1965         1.00         1.00         0.92         1.00         0.95         0.97         0.73         0.31         0.93         0.00           1966         1.00         1.00         0.98         1.00         0.24         0.74         0.49         0.53         0.56         0.00           1966         1.00         1.00         1.00         1.00         1.00         1.00         0.98         0.60         0.65         0.91         0.78         0.88         0.76         0.00           1968         1.00         1.00         1.00         1.00         1.00         0.98         0.63         0.06         0.65         0.91         0.54         0.07         0.00           1970         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         0.98         0.89         0.85         0.72							0.39	0.87	0.74	0.16	0.00
1963         1.00         1.00         0.94         1.00         1.00         0.71         0.95         0.36         0.98         0.00           1964         1.00         1.00         0.25         0.25         0.19         0.66         0.23         0.05         0.03         0.00           1965         1.00         1.00         0.92         1.00         0.95         0.97         0.73         0.31         0.93         0.00           1966         1.00         1.00         0.98         1.00         0.24         0.74         0.49         0.53         0.56         0.00           1967         1.00         1.00         1.00         1.00         1.00         0.91         0.78         0.88         0.76         0.00           1969         1.00         1.00         1.00         1.00         1.00         1.00         0.98         0.95         0.77         0.97         0.00           1970         1.00         1.00         1.00         1.00         1.00         0.98         0.89         0.60         0.83         0.60         0.00           1971         1.00         1.00         1.00         0.98         0.89         0.60 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1964         1.00         1.00         0.25         0.25         0.19         0.66         0.23         0.05         0.03         0.00           1966         1.00         1.00         0.92         1.00         0.95         0.97         0.73         0.31         0.93         0.00           1967         1.00         1.00         1.00         1.00         1.00         1.00         0.91         0.74         0.49         0.53         0.56         0.00           1968         1.00         1.00         0.98         0.63         0.06         0.65         0.91         0.54         0.07         0.00           1969         1.00         1.00         1.00         1.00         1.00         1.00         1.00         0.98         0.65         0.91         0.54         0.07         0.00           1970         1.00         1.00         1.00         1.00         1.00         0.98         0.95         0.77         0.97         0.00           1971         1.00         1.00         1.00         0.98         0.89         0.60         0.83         0.60         0.00           1972         1.00         1.00         1.00         0.93 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1966											0.00
1967         1.00         1.00         1.00         1.00         1.00         0.91         0.78         0.88         0.76         0.00           1968         1.00         1.00         0.98         0.63         0.06         0.65         0.91         0.54         0.07         0.00           1970         1.00         1.00         1.00         1.00         1.00         0.98         0.95         0.77         0.97         0.00           1971         1.00         1.00         1.00         1.00         0.98         0.89         0.60         0.83         0.60         0.00           1972         1.00         1.00         1.00         1.00         0.93         0.32         0.62         0.56         0.76         0.17         0.00           1973         1.00         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1975         1.00         1.00         1.00         0.09         1.00         0.45         0.84 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1968         1.00         1.00         0.98         0.63         0.06         0.65         0.91         0.54         0.07         0.00           1969         1.00         1.00         1.00         1.00         0.98         0.95         0.77         0.97         0.00           1970         1.00         1.00         1.00         1.00         0.45         0.99         0.85         0.72         0.02         0.00           1971         1.00         1.00         1.00         0.98         0.89         0.60         0.83         0.60         0.00           1972         1.00         1.00         1.00         1.00         0.93         0.32         0.62         0.56         0.76         0.17         0.00           1973         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         0.99         0.98         0.68         0.97         0.95         0.00           1975         1.00         1.00         0.47         0.00         0.00         0.45         0.84         0.92         0.34         0.00           1											
1969         1.00         1.00         1.00         1.00         1.00         0.98         0.95         0.77         0.97         0.00           1970         1.00         1.00         1.00         0.14         0.45         0.99         0.85         0.72         0.02         0.00           1971         1.00         1.00         1.00         1.00         0.98         0.89         0.60         0.83         0.60         0.00           1972         1.00         1.00         1.00         0.93         0.32         0.62         0.56         0.76         0.17         0.00           1973         1.00         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         0.99         0.98         0.68         0.97         0.95         0.00           1975         1.00         1.00         1.00         0.99         1.00         0.45         0.84         0.92         0.34         0.00           1977         1.00         1.00         0.00         0.00         0.00         0.02         0.01         0.00         0.00 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.00</td></t<>											0.00
1971         1.00         1.00         1.00         1.00         0.98         0.89         0.60         0.83.         0.60         0.00           1972         1.00         1.00         1.00         0.93         0.32         0.62         0.56         0.76         0.17         0.00           1973         1.00         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         1.00         0.99         0.98         0.68         0.97         0.95         0.00           1975         1.00         1.00         1.00         0.99         1.00         0.45         0.84         0.92         0.34         0.00           1976         1.00         1.00         0.47         0.00         0.00         0.24         0.16         0.09         0.00         0.00           1977         1.00         1.00         1.00         1.00         0.00         0.00         0.01         0.00         0.00         0.00         0.00         0.91         0.97         0.90         0.95         0.89         0.00         0.91         0.97         0.90	1969	1.00	1.00	1.00	1.00	1.00	0.98	0.95	0.77		
1972         1.00         1.00         1.00         0.93         0.32         0.62         0.56         0.76         0.17         0.00           1973         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         0.99         0.98         0.68         0.97         0.95         0.00           1975         1.00         1.00         0.099         1.00         0.45         0.84         0.92         0.34         0.00           1976         1.00         1.00         0.47         0.00         0.00         0.24         0.16         0.09         0.00         0.00           1977         1.00         1.00         0.00         0.00         0.015         0.04         0.00         0.00         1.00         1.00         0.00         0.00         1.00         0.00											
1973         1.00         1.00         1.00         0.99         0.94         0.91         0.75         0.44         0.00           1974         1.00         1.00         1.00         0.99         0.98         0.68         0.97         0.95         0.00           1975         1.00         1.00         1.00         0.99         1.00         0.45         0.84         0.92         0.34         0.00           1976         1.00         1.00         0.47         0.00         0.00         0.24         0.16         0.09         0.00         0.00           1977         1.00         1.00         0.00         0.00         0.15         0.04         0.00         0.00         0.00           1978         1.00         1.00         1.00         0.99         0.97         0.90         0.95         0.89         0.00           1979         1.00         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1980         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1											
1975         1.00         1.00         0.99         1.00         0.45         0.84         0.92         0.34         0.00           1976         1.00         1.00         0.47         0.00         0.00         0.24         0.16         0.09         0.00         0.00           1977         1.00         1.00         0.00         0.00         0.00         0.15         0.04         0.00         0.00         0.00           1978         1.00         1.00         1.00         1.00         0.99         0.97         0.90         0.95         0.89         0.00           1979         1.00         1.00         0.99         0.97         0.99         0.63         0.69         0.66         0.23         0.00           1980         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1.00         0.98         0.82         0.05         0.67         0.57         0.51         0.11         0.00           1982         1.00         1.00         1.00         1.00         0.94         0.98         1.00         0.94         0.99         0.92 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.44</td><td>0.00</td></t<>										0.44	0.00
1976         1.00         1.00         0.47         0.00         0.00         0.24         0.16         0.09         0.00         0.00           1977         1.00         1.00         0.00         0.00         0.00         0.15         0.04         0.00         0.00         0.00           1978         1.00         1.00         1.00         0.99         0.97         0.90         0.95         0.89         0.00           1979         1.00         1.00         0.99         0.97         0.99         0.63         0.69         0.66         0.23         0.00           1980         1.00         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1.00         0.98         0.82         0.05         0.67         0.57         0.51         0.11         0.00           1982         1.00         1.00         1.00         1.00         1.00         0.91         0.97         0.92         1.00         0.94         0.00           1984         1.00         1.00         1.00         1.00         0.94         0.98         0.71         0.17 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1977         1.00         1.00         0.00         0.00         0.00         0.15         0.04         0.00         0.00         0.00           1978         1.00         1.00         1.00         0.99         0.97         0.90         0.95         0.89         0.00           1979         1.00         1.00         0.99         0.97         0.99         0.63         0.69         0.66         0.23         0.00           1980         1.00         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1.00         0.98         0.82         0.05         0.67         0.57         0.51         0.11         0.00           1982         1.00         1.00         1.00         1.00         1.00         0.91         0.97         0.92         1.00         0.00           1983         1.00         1.00         1.00         1.00         1.00         0.94         0.98         1.00         0.94         0.00           1984         1.00         1.00         0.74         0.98         0.06         0.36         0.32         0.17         0.17 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1978         1.00         1.00         1.00         0.99         0.97         0.90         0.95         0.89         0.00           1979         1.00         1.00         0.99         0.97         0.99         0.63         0.69         0.66         0.23         0.00           1980         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1.00         0.98         0.82         0.05         0.67         0.57         0.51         0.11         0.00           1982         1.00         1.00         1.00         1.00         1.00         0.91         0.97         0.92         1.00         0.00           1983         1.00         1.00         1.00         1.00         1.00         0.94         0.98         1.00         0.94         0.99         1.00         0.90           1984         1.00         1.00         0.74         0.98         0.06         0.36         0.32         0.17         0.17         0.00           1985         1.00         1.00         1.00         0.98         0.06         0.36         0.32         0.17 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
1980         1.00         1.00         1.00         0.93         0.98         0.97         0.82         0.45         0.00           1981         1.00         1.00         0.98         0.82         0.05         0.67         0.57         0.51         0.11         0.00           1982         1.00         1.00         1.00         1.00         0.91         0.97         0.92         1.00         0.00           1983         1.00         1.00         1.00         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         1.00         0.94         0.98         0.73         0.71         0.17         0.00           1985         1.00         1.00         0.74         0.98         0.06         0.36         0.32         0.17         0.29         0.00						0.99		0.90	0.95		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$											
1982         1.00         1.00         1.00         1.00         1.00         0.91         0.97         0.92         1.00         0.00           1983         1.00         1.00         1.00         1.00         0.94         0.98         1.00         0.94         0.00           1984         1.00         1.00         0.99         0.92         0.92         0.88         0.73         0.71         0.17         0.00           1985         1.00         1.00         0.74         0.98         0.06         0.36         0.32         0.17         0.29         0.00           1986         1.00         1.00         1.00         0.91         0.85         1.00         0.98         0.49         0.00           1987         1.00         1.00         0.98         0.07         0.00         0.32         0.47         0.54         0.02         0.00           1988         1.00         1.00         0.38         0.01         0.00         0.74         0.22         0.08         0.01         0.00           1989         1.00         1.00         1.00         0.08*         0.01         0.00         0.37         0.22         0.97         0.68         <											
1983       1.00       1.00       1.00       1.00       0.94       0.98       1.00       0.94       0.00         1984       1.00       1.00       0.99       0.92       0.92       0.88       0.73       0.71       0.17       0.00         1985       1.00       1.00       0.74       0.98       0.06       0.36       0.32       0.17       0.29       0.00         1986       1.00       1.00       1.00       0.91       0.85       1.00       0.98       0.49       0.00         1987       1.00       1.00       0.98       0.07       0.00       0.32       0.47       0.54       0.02       0.00         1988       1.00       1.00       0.38       0.01       0.00       0.74       0.22       0.08       0.01       0.00         1989       1.00       1.00       1.00       0.08*       0.37       0.22       0.97       0.68       0.00											
1985       1.00       1.00       0.74       0.98       0.06       0.36       0.32       0.17       0.29       0.00         1986       1.00       1.00       1.00       0.91       0.85       1.00       0.98       0.49       0.00         1987       1.00       1.00       0.98       0.07       0.00       0.32       0.47       0.54       0.02       0.00         1988       1.00       1.00       0.38       0.01       0.00       0.74       0.22       0.08       0.01       0.00         1989       1.00       1.00       1.00       1.00       0.08*       0.37       0.22       0.97       0.68       0.00	1983	1.00	1.00	1.00	1.00						
1986       1.00       1.00       1.00       0.91       0.85       1.00       0.98       0.49       0.00         1987       1.00       1.00       0.98       0.07       0.00       0.32       0.47       0.54       0.02       0.00         1988       1.00       1.00       0.38       0.01       0.00       0.74       0.22       0.08       0.01       0.00         1989       1.00       1.00       1.00       0.08*       0.37       0.22       0.97       0.68       0.00											
1987     1.00     1.00     0.98     0.07     0.00     0.32     0.47     0.54     0.02     0.00       1988     1.00     1.00     0.38     0.01     0.00     0.74     0.22     0.08     0.01     0.00       1989     1.00     1.00     1.00     0.08     0.37     0.22     0.97     0.68     0.00											
1989 1.00 1.00 1.00 1.00 0.08 0.37 0.22 0.97 0.68 0.00	1987			0.98	0.07	0.00	0.32	0.47	0.54	0.02	0.00
1991 1.00 1.00 0.99 0.28 0.16 0.09 0.03 0.57 0.04 0.00											0.00
1992 1.00 1.00 0.93 0.66 0.00 0.21 0.76 0.32 0.08 0.00					0.66	0.00	0.21	0.76	0.32	0.08	0.00

TABLE 2

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1968 LEVEL OF DEVELOPMENT

		CHIPPS	ISLAND				ROE I	SLAND		
YEAR 1922 1923	FEB 1.00 1.00	MAR 1.00 1.00	APR 0.95 0.49		JUN 1.00 0.67	FEB 0.52 0.75	MAR 0.69 0.20	APR 0.27 0.06	MAY 0.43 0.31	JUN 0.00 0.00
1924 1925 1926	1.00 1.00 1.00	1.00 1.00 1.00	0.00 0.91 0.70	0.00 1.00 1.00	0.00 0.70 0.01	0.22 0.45 0.35	0.19 0.93 0.79	0.00 0.20 0.10	0.00 0.50 0.48	0.00 0.00 0.00
1927 1928	1.00	1.00	1.00	1.00	0.91	0.83	0.96	0.61 0.91	0.82	0.00
1929 1930	1.00	1.00 1.00	0.26 0.98	0.00	0.04	0.25 0.65	0.18 0.45	0.03	0.00	0.00
1931 1932	1.00	0.71 1.00	0.18	0.00	0.00	0.37	0.07	0.03	0.00	0.00
1933 1934	1.00	0.02	0.81	0.04	0.03	0.31 0.67 0.77	0.03 0.36 0.35	0.13 0.13 0.19	0.01 0.00 0.96	0.00
1935 1936 1937	1.00 1.00 1.00	1.00 1.00 1.00	0.90 0.98 0.99	1.00 1.00 1.00	0.96 0.71 0.98	0.77 0.91 0.21	0.33	0.19	0.50	0.00
1938 1939	1.00	1.00	1.00	1.00	1.00	0.77 0.36	0.94	0.97	0.95	0.00
1940 1941	1.00	1.00	1.00	1.00	0.74	0.94	0.95 0.93	0.93 0.83	0.77 0.77	0.00
1942 1943	1.00 1.00	1.00 1.00	0.92 1.00	1.00 1.00	0.97 0.63	0.95 0.96	0.93 0.73	0.22 0.88	0.78 0.66	0.00
1944 1945	1.00	1.00	0.83	0.02	0.45	0.36 0.52 0.87	0.30 0.88 0.25	0.14 0.20 0.24	0.01 0.12 0.33	0.00 0.00 0.00
1946 1947 1948	1.00 1.00 1.00	1.00 1.00 0.33	0.93 0.96 0.54	0.99 0.16 1.00	0.69 0.01 0.94	0.87 0.27 0.78	0.25	0.24	0.03	0.00
1949 1950	1.00	0.97	0.99	0.97	0.49	0.20	0.11	0.56	0.26	0.00
1951 1952	1.00	1.00	0.97	0.83	0.32	0.92	0.83	0.35	0.11	0.00
1 <sub>953</sub> 1954	1.00	1.00	0.88	0.97	0.48	0.97 0.83	0.33	0.17 0.65	0.25	0.00
1955 1956 1957	1.00 1.00 1.00	0.99 1.00 1.00	0.25 0.99 0.99	0.04 0.99 0.32	0.37 0.99 0.78	0.56 0.98 0.37	0.12 0.85 0.69	0.03 0.48 0.58	0.01 0.36 0.04	0.00
1957 1958 1959	1.00	1.00	1.00	1.00	1.00	0.85	0.98	0.83	0.95	0.00
1960 1961	1.00	1.00	0.99	0.50	0.03	0.43	0.78	0.53 0.14	0.06 0.01	0.00
1962 1963	1.00	1.00	0.95	1.00	0.31	0.36	0.88	0.27	0.52	0.00
1964 1965	1.00	0.99 1.00 1.00	0.14 0.84 0.96	0.03 1.00 0.98	0.03 0.76 0.05	0.70 0.97 0.77	0.14 0.59 0.35	0.02 0.15 0.31	0.01 0.80 0.28	0.00 0.00 0.00
1966 1967 1968	1.00 1.00 1.00	1.00	1.00 0.97	1.00	1.00	0.92	0.66	0.74	0.49	0.00
1969 1970	1.00	1.00	0.99	1.00	1.00	0.99	0.92	0.57 0.50	0.91	0.00
1971 1972	1.00	1.00	1.00	0.99 0.53	0.89	0.90	0.45	0.66	0.31	0.00
1973 1974	1.00	1.00 1.00 1.00	0.99 1.00 1.00	0.95 1.00 0.88	0.97 0.96 0.99	0.94 0.98 0.49	0.85 0.54 0.75	0.55 0.93 0.82	0.19 0.86 0.14	0.00 0.00 0.00
1975 1976 1977	1.00 1.00 1.00	0.94	0.30	0.00	0.00	0.49	0.73	0.04	0.00	0.00
1978 1979	1.00	1.00	1.00	1.00	0.96	0.97 0.66	0.83	0.89	0.71	0.00
1980 1981	1.00	1.00	1.00	0.95	0.68	0.98	0.95	0.64	0.20	0.00
1982 1983 1984	1.00 1.00 1.00	1.00 1.00 1.00	1.00 1.00 0.99	1.00 1.00 0.51	0.99 1.00 0.64	0.93 0.95 0.89	0.95 0.96 0.60	0.83 0.99 0.49	0.99 0.83 0.06	0.00
1985 1986	1.00	1.00	0.58	0.82	0.01	0.39	0.21	0.07	0.11	0.00
1987 1988	1.00	1.00 0.99	0.97	0.01	0.00	0.36	0.33	0.32	0.01	0.00
1989 1990	1.00	0.99	1.00	0.99	0.01	0.40	0.13	0.93	0.39	0.00 0.00 0.00
1991 1992	1.00	0.00	0.97 0.86	0.03	0.03	0.10 0.24	0.02	0.35	0.01	0.00

TABLE 3

MONTHLY FRACTIONS OF REQUIRED X2 STANDARDS AT CHIPPS AND ROE ISLANDS AT 1975 LEVEL OF DEVELOPMENT

	CHIPP	S ISLAND				ROE	ISLAND		
1922 1 1923 1 1924 1 1925 1 1926 1 1927 1 1928 1 1929 1 1930 1 1931 1 1932 1 1933 1 1934 1 1935 1 1936 1 1937 1 1938 1 1939 1 1940 1 1941 1 1942 1 1943 1 1944 1 1945 1 1944 1 1945 1 1946 1 1947 1 1948 1 1948 1 1950 1 1951 1 1952 1 1953 1 1954 1 1955 1 1955 1 1955 1 1955 1 1955 1 1956 1 1957 1 1958 1 1959 1 1956 1 1961 1 1962 1 1963 1 1964 1 1965 1 1966 1 1967 1 1968 1 1966 1 1967 1 1968 1 1969 1 1960 1 1961 1 1966 1 1967 1 1968 1 1969 1 1960 1 1961 1 1962 1 1966 1 1967 1 1968 1 1966 1 1967 1 1971 1 1972 1 1973 1 1974 1 1975 1 1977 1	FEB MAR .00 1.00 .00 1.00 .00 1.00 .00 1.00 .00	S ISLAND  APR 0.93 0.40 0.00 0.87 0.62 0.99 1.00 0.74 0.74 0.86 0.97 0.97 0.97 1.00 0.89 1.00 0.89 1.00 0.89 1.00 0.89 1.00 0.89 1.00 0.99 1.00 0.99 1.00 0.99 0.99 0.9	MAY 0.98 0.994 0.00 0.99 0.99 1.00 0.36 0.00 0.47 0.01 0.00 1.00	JUN 1.00 0.43 0.00 0.46 0.00 0.78 0.10 0.02 0.01 0.00 0.73 0.01 0.00 0.91 0.47 0.94 1.00 0.00 0.51 0.99 0.91 0.39 0.23 0.54 0.45 0.00 0.86 0.26 0.48 0.14 1.00 0.26 0.20 0.17 0.96 0.56 1.00 0.01 0.00 0.14 0.00 0.14 0.00 0.14 0.00 0	FEB 0.54 0.76 0.23 0.47 0.36 0.84 0.66 0.27 0.67 0.39 0.64 0.32 0.69 0.79 0.92 0.78 0.38 0.94 0.95 0.96 0.38 0.97 0.84 0.88 0.28 0.79 0.21 0.78 0.93 0.97 0.84 0.58 0.98 0.98 0.98 0.97 0.84 0.58 0.98 0.97 0.84 0.58 0.98 0.97 0.84 0.58 0.98 0.97 0.84 0.58 0.98 0.97 0.84 0.58 0.98 0.97 0.84 0.58 0.98 0.99 0.91 0.67 0.97 0.99 0.91 0.67 0.95 0.99 0.91 0.67	MAR 0.61 0.14 0.90 0.73 0.94 0.41 0.13 0.35 0.02 0.29 0.28 0.90 0.55 0.09 0.28 0.91 0.64 0.85 0.12 0.08 0.12 0.08 0.12 0.08 0.12 0.08 0.09 0.12 0.08 0.09 0.08 0.09 0	APR 0.19 0.04 0.09 0.13 0.06 0.49 0.86 0.02 0.28 0.02 0.28 0.02 0.08 0.13 0.28 0.49 0.09 0.74 0.15 0.82 0.09 0.74 0.15 0.82 0.09 0.74 0.15 0.82 0.01 0.04 0.20 0.36 0.46 0.71 0.01 0.01 0.01 0.01 0.01 0.01 0.01	MAY 0.28 0.19 0.00 0.34 0.33 0.71 0.01 0.00 0.05 0.01 0.02 0.34 0.64 0.65 0.50 0.07 0.21 0.64 0.65 0.50 0.07 0.21 0.05 0.16 0.31 0.06 0.07 0.21 0.05 0.01 0.05 0.01 0.05 0.07 0.01 0.05 0.01 0.05 0.01 0.05 0.07 0.01 0.05 0.01 0.01 0.02 0.01 0.02 0.03 0.01 0.02 0.03 0.01 0.02 0.03 0.01 0.03 0.03 0.01 0.03 0	JUN 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.
1974       1         1975       1         1976       1         1977       1         1978       1         1979       1         1980       1         1981       1         1982       1         1983       1         1984       1         1985       1         1986       1         1987       1	.00 1.00 .00 1.00 .00 0.00 .00 0.00 .00 1.00 .00 1.00 .00 1.00 .00 0.96 .00 1.00 .00 1.00 .00 1.00 .00 1.00 .00 1.00	1.00 1.00 0.23 0.00 1.00 0.98 0.99 0.94 1.00 0.98 0.48 1.00	1.00 0.66 0.00 0.00 1.00 0.40 0.84 0.09 1.00 0.22 0.54 0.88 0.00	0.90 0.97 0.00 0.00 0.90 0.86 0.44 0.00 0.98 1.00 0.39 0.00 0.36 0.00	0.98 0.51 0.28 0.18 0.98 0.68 0.98 0.72 0.93 0.95 0.90 0.41 0.88 0.37	0.46 0.68 0.07 0.01 0.78 0.46 0.94 0.35 0.93 0.95 0.52 0.16 0.99	0.89 0.73 0.02 0.00 0.82 0.32 0.52 0.20 0.75 0.98 0.37 0.05	0.77 0.08 0.00 0.00 0.57 0.05 0.12 0.02 0.99 0.72 0.03 0.06 0.14 0.00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1989 1 1990 1 1991 1	.00 0.00 .00 0.00 .00 0.00 .00 0.00 .00 1.00	0.17 1.00 0.69 0.96 0.81	0.00 0.97 0.00 0.01 0.04	0.00 0.01 0.00 0.01 0.00	0.78 0.42 0.62 0.11 0.25	0.10 0.10 0.07 0.01 0.56	0.02 0.89 0.07 0.24 0.10	0.00 0.25 0.00 0.01 0.01	0.00 0.00 0.00 0.00

RQ. Box /643 e San Francisco California 94120-7643 Tel: 415/974·5721 Fax: 415/974-5724

To. FRED CANNON

Juimun: AM CHNN See Chairman MIN BRYSING recutive Discourt. ARY M. ANIMERIN



## ≇FORNIA BUSINESS ROUNDTABLE

July 1, 1994

The Honorable Petc Wilson Governor of California State Capitol . Sacramento, CA 95814

ALSO PRESIDENT CLINTON.

Dear Govenor Wilson:

As business leaders in California, we applaud the recently signed state/federal fromework agreement and strongly support rapid approval and implementation of water quality standards for the Bay-Dalta that protect both our environment and our aconomy.

Hany of us worked hard to promote and secure the passage of water marketing legislation. We believe that an expanded water market -- supported by state and federal law and developed by private initiative -- Would benefit all Californians. Instead, government inaction in the Day-Delta has provented the market for water from developing and blocked progress toward resolving many other crucial water issues.

Tackling the problems of the Bay-Delta will require state-federal cooperation on two key steps. First, standards must be established this year for the estuary. Second, we must commence longer-range comprehensive multi-species planning to protect Bay-Delta habitats and avoid the inevitable conflicts arising from a species-by-species regulatory approach.

The continuing gridlock in setting standards for the Bay-Dalta is simply unacceptable. The lack of approved standards is creating uncertainty that threatens the economic recovery we so desporately need. Please commit to achieving standards for the Bay-Dalta this year.

Sam Ginn Chairman & CEO

AirTouch Communications Transamerica Corporation Bank of America

James R. Harvey

Chairman

Sincerely,

Richard M. Rosenberg Chairman & CEO

To Lisa Ge	x Transmittal Memo 1 of pages 1
Cc.	Urid Can Mac
<b>Dept.</b>	Prone + 415-624-0591
Fex : 202-20	8-3837 Fax #



#### UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

**REGION IX** 

75 Hawthorne Street San Francisco, CA 94105-3901

JUL - 5 1994

OFFICE OF THE REGIONAL ADMINISTRATOR

Honorable Gary A. Condit U.S. House of Representatives 1123 Longworth Building Washington, D.C. 20515-0518

Dear Mr. Condit:

It was a pleasure to meet with you and your constituents regarding issues of concern in the Central Valley. We would like to thank you and your staff again for organizing a productive and informative meeting and look forward to returning in August to discuss the complex issues facing your constituents.

In my April 21 interim response to your April 12 letter I made a commitment to provide an update on the issues that were raised in your letter and discussed at our meeting in Modesto. I regret the delay in providing further information. Many of these issues are ongoing and ever-changing. Nevertheless, the information provided below is the most current assessment of the issues raised in your letter.

Bay/Delta Water Quality Standards:

We are carefully reviewing the comments submitted on the proposed rule, and have signed a Settlement Agreement requiring EPA to set final standards by December 15, 1994. We are also working closely with the State and Federal agencies and interest groups in developing the final standards. These have included further meetings on issues like water transfer potential, the Endangered Species Act implementation and other of the issues we discussed. I agree that a continued dialogue between our staff and the various agricultural and water interests is essential to create standards that protect the estuary while minimizing impacts on the State's economy. I am most grateful for your help facilitating these discussions and am impressed with the stakeholders' willingness to talk with each other and with us through this process.

On June 20, we announced the completion of a framework agreement with the State of California to better coordinate state and federal agency actions in the Bay/Delta estuary. The agreement establishes a process for EPA and the State Water Resources Control Board to work towards adoption of mutually

acceptable water quality standards, and for the state and federal agencies to develop a long-term strategy to address Delta water quality and reliability issues. I am personally quite pleased with the progress we are all making and know that it is what the stakeholders, including agriculture have wanted. We briefed congressional staff on the agreement in Washington on June 22nd, and appeared before the Senate Subcommittee on Water and Power on June 23. When we meet again in August, we can brief you on the framework agreement, and our progress to date.

#### Emission Reduction Credits (ERC):

We understand the need for industry to have as much certainty as possible in planning future expansion. To meet this need while still meeting the requirement that any ERC used to offset new source growth is surplus to reductions needed for attaining the health based clean air standards. My staff is working not only with our Headquarters staff but also with David Crow of the San Joaquin AQMD to address this issue of national importance. Options under consideration include the following:

- 1) A time limit on the life of the credits. Credits would be adjusted for all current and anticipated future requirements at the time they are created. No further adjustment would occur, but after a fixed period of time (for example, after five years), the credit would no longer be usable.
- 2) Accounting for required reductions in the aggregate. Under this option, credits would be adjusted for all current and anticipated future requirements only at the time they are created. The reductions required at the time of use would be calculated by the permitting agency. If additional reductions are needed, the permitting agency would be responsible for adopting measures to achieve these reductions in the aggregate.

We expect to present details of these options to the Air Resources Board and the Air District in the next four to six weeks for their consideration. We would welcome your further thoughts as well on this most challenging issue.

#### PM-10 Regulations:

EPA fully supports the San Joaquin Valley PM-10 Research Project. In addition to providing multi-year funding, EPA actively participates on both the Policy and Technical Committees that oversee the study. However, as you know, Federal Clean Air Act requirements for PM-10 plan submittals are due before the scheduled completion of the PM-10 Research Project. Since we

have no flexibility with regard to statutory requirements of the Act we have encouraged the San Joaquin Valley PM-10 Study Policy and Technical Committees to structure the study such that interim data and information is provided in time to support PM-10 plan development and implementation.

The Study Committees are very cognizant of this issue and accordingly are moving forward. We will continue to work closely with the Study Committees and the San Joaquin Valley Unified Air Pollution Control District to ensure timely submittal of the required PM-10 plan elements. The recently appropriated FY 94 funds for PM10 in California has been allocated totally to the San Joaquin study and should greatly help development of these elements. We will keep you apprised of our progress.

#### FIFRA - Farmworker Protection Regulations:

California's leadership in pesticide regulation, particularly with respect to fieldworker protection, is well recognized. In the process of revising the Worker Protection Standards (WPS), EPA relied heavily on California's experience with worker protection, and parts of the rule do duplicate California requirements. Our office here in Region 9 is working closely with the staff of the California Department of Pesticide Regulation (CDPR) to reconcile the state regulations with the federal regulations. EPA has developed a policy for reviewing state requests for equivalency for those sections of state regulations which are different in practice from the WPS, but which provide as strong or stronger protection.

The state's requests will be considered with a focus on results, striving for the spirit of cooperation, common sense, and best practical professional judgement characteristic of our partnership relation with the State. To date these discussions have focused on the central display of information, the design of signs to warn workers of treated fields, the ventilation of greenhouses, the training of early-entry workers and California's definition of the treated field. In each of these areas, the staff of both DPR and EPA agree that they are coming to mutually acceptable interpretations of the federal and state regulatory requirements that will not result in a disruption of the existing California program.

However, in some areas, the WPS has moved beyond California's existing program, and CDPR is revising its regulations to meet these requirements. Again, we are working closely with the State and with the agricultural community to assist them in implementing the new requirements. If you have any further thoughts please let me know.

We look forward to working closely with you and your constituents as we continue to work towards resolution of these special Central Valley issues. I look forward to seeing you in August. In the meantime, if we can be of further assistance, please call me or my Congressional Liaison Officer, Catherine Roberts, at 415-744-1562.

Yours,

Felicia Marcus

Regional Administrator

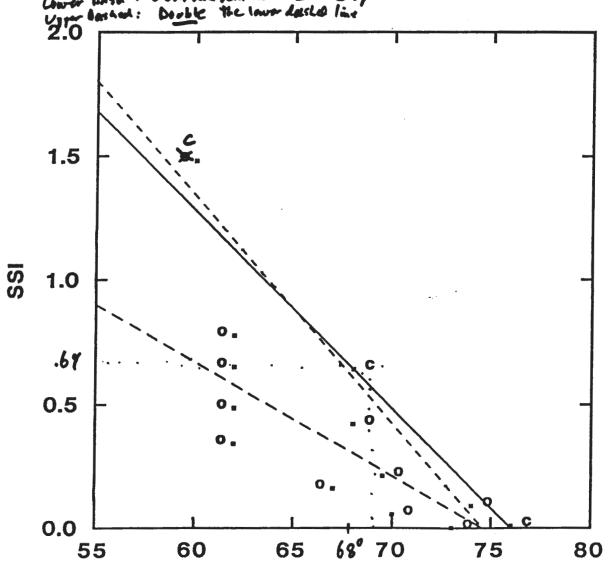
# Salmon Background

## Sacramento Kiver From Bree H. 07/07/44

C = O Cross Channel Closed (April - line - Fix 0 = & Cools Channel Opened

Hart Line: Real observed maxima (It will actually go thru the "E's")

Lower Bash : Observed year with BX Oppen Dooble the lower desile line

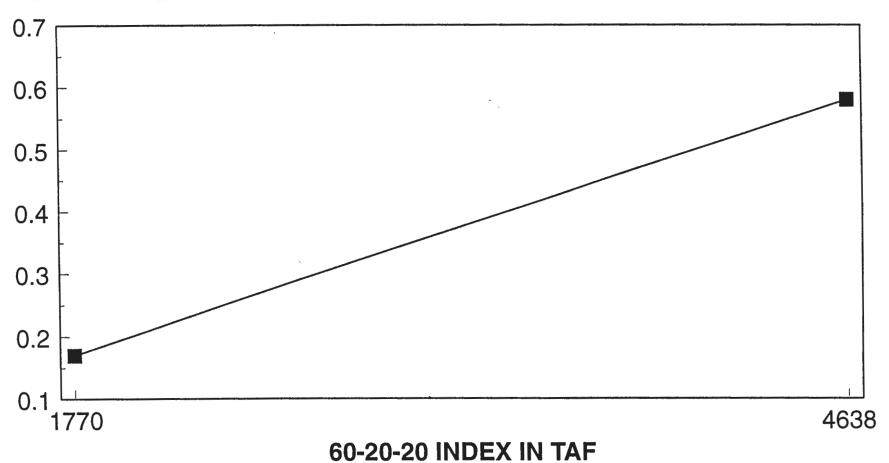


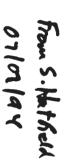
Notes: Temp (i) Cline ok except how to you give incoming for temp achous

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AN YEARS						
Calc w/DWRSIM Calc w/DWRSIM Calc w/DWRSIM Calc w/DWRSIM no DWRSIM no DWRSIM	8000 8000 8000 8000 8000 8000	Apr15-May15 Apr15-May15 Apr15-May15 Apr15-May15 Apr1-May30 Apr1-May30	2750 1500 2750 1500 2750 1500	no no yes yes no no	0.11 0.12 0.48 0.51 0.2 0.21	
BN YEARS						
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D YEARS						
Calc w/DWRSIM Calc w/DWRSIM Calc w/DWRSIM Calc w/DWRSIM no DWRSIM no DWRSIM	4000 4000 4000 4000 4000 4000	Apr15-May15 Apr15-May15 Apr15-May15 Apr15-May15 Apr1-May30 Apr1-May30	2750 1500 2750 1500 2750 1500	no no yes yes no no	0.07 0.08 0.33 0.35 0.11 0.12	
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# AVERAGE 60-20-20 INDICES FOR RELEASE C AND W YEARS USING QUARTILE SURVIVAL INDICES

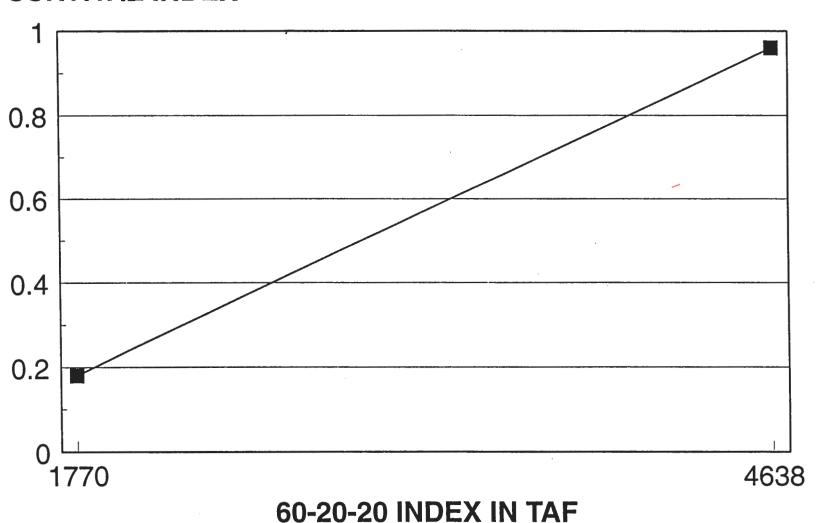
## **SURVIVAL INDEX**

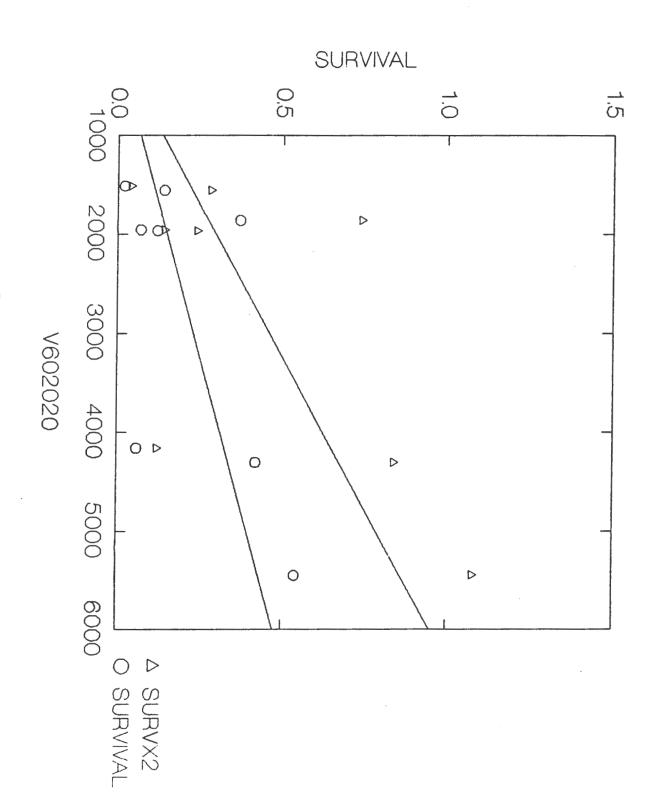




# AVERAGE 60-20-20 INDICES FOR RELEASE C AND W YEARS USING AVERAGE SURVIVAL INDICES DOUBLED

## **SURVIVAL INDEX**





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DEP VAR:SUR\ ADJUSTED SQL	/IVAL N: JARED MULTIPLE R:		R: 0.642 SQUARED MARD ERROR OF ESTIMA								
VARIABLE	COEFFICIENT	STD ERROR S	TTD COEF TOLERANCE	T P(2 TAIL)							
CONSTANT V602020	-0.015 0.000	0.127 0.000	0.000 . 0.642 .100E+01	-0.120 0.909 2.050 0.086							
ANALYSIS OF VARIANCE											
SOURCE	SUM-OF-SQUARES	DF MEAN-SQUAR	E F-RATIO	Р							
REGRESSION RESIDUAL	0.111 0.158	1 0.11 6 0.02		0.086							
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DEP VAR:SURV ADJUSTED SQU	IVAL N: ARED MULTIPLE R:	8 MULTIPLE R .262 STANDA	: 0.606 SQUARED M RD ERROR OF ESTIMA	ULTIPLE R: 0.368 TE: 0.168							
""RIABLE	COEFFICIENT	STD ERROR S	TD COEF TOLERANCE	T P(2 TAIL)							
CONSTANT UNIMPWY	0.046 0.000	0.110 0.000	0.000 . 0.606 .100E+01	0.415 0.692 1.867 0.111							
	ANALYS	SIS OF VARIANCE									
SOURCE	SUM-OF-SQUARES	DF MEAN-SQUAR	F-RATIO	Р							
REGRESSION RESIDUAL	0.099 0.170	1 0.099 6 0.029		0.111							
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CONSTANT UNIMPAJ	0.052 0.000	0.126 0.000	0.000 . 0.528 .100E+01	0.410 0.696 1.524 0.178							

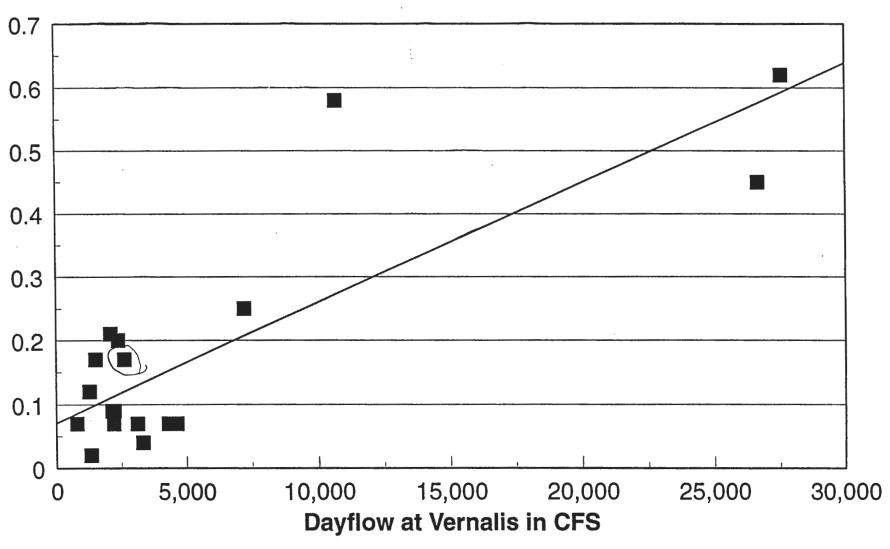
#### ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	Р
REGRESSION	0.075 0.194	1 6	0.075	2.323	0.178

## San Joaquin Salmon Smolt Survival Index vs Dayflow at Vernalis in CFS averaged over 10 Days after Release

Survival = .071 + .00001SJR, r2 = 0.69, p<.001, n=19





\*\*note: 1993 Mossdale flow data is from San Joaquin Model Report; others are from dayflow 1982 and 1991 UOldR survival estimated by using average proportional survival for UOldRiver releases vs Dos Reis releases, excluding 1985, which is an outlier apparently because the marking method was dye rather than fin clip. Avg=0.43, range= 0.64-0.25; n=5

All DosRUoldR survivals estimated by weighting reach survivals by proportion of flow, and summing; others used directly

C:SJRLSDAT.WK4
airria adatalist

sjrrlsedatalis	st		survival	surv/1.8	10 day avg SJR	10 day avg export		10 day avg qwest
DosRUoldR		1982	0.45	0.25	26670	9372	1960	31173
DosRUoldR		1985	0.61	0.34	2370	5838	2065	685
DosRUoldR		1986	0.25	0.14	7215	5074	3125	7798
DosRUoldR		1987	0.20	0.11	2386	6152	1629	57
DosRUoldR	April	1989	0.09	0.05	2148	10346	1395.5	-1793
DosRUoldR	May	1989	0.07	0.04	2203	2563	2130	3434
DosRUoldR	April	1990	0.02	0.01	1342	9649	677.6	-1434
DosRUoldR	May	1990	0.02	0.01	1325	2556	2130	1854
DosRUoldR		1991	0.07	0.04	799.2	5576	494.8	-195
Mossdale	April	1992	0.17	0.09	1530	2682	1865	261
Mossdale	April	1992	0.12	0.07	1274	1218	1900	1451
<b>\</b> Mossdale	April	1993	0.04	0.02	3321	6997		2692
Mossdale	April	1993	0.07	0.04	4630	1519		4953
Mossdale	May	1993	0.07	0.04	4309	1512		4553
Mossdale	May	1993	0.07	0.04	3111	3815		1533
Snelling		1982	0.62	0.34	27570	9491		
L Stan	•	1986	0.58	0.32	10710	5436		
L Tuol		1987	0.17	0.09	2627	7357		
L Stan	•	1988	0.09	0.05	2233	7648		
L Stan	1	1989	0.21	0.12	2096	10336		

April-May				
avg dflow	WY Unimp	A-J UNIMP	60-20-20	Class
	TAF	TAF		
20773	11414	7004	5446	W
2287	3603	2407	2404	D
14088	9497	4922	4306	W
2517	2083	1483	1861	С
1933	3563	2424	1964	С
1294	2460	1592	1514	С
1155	3205	2568	1955	С
1109	2578	1659	1558	С
	8329	5586	4161	W
	avg dflow 20773 2287 14088 2517 1933 1294 1155	avg dflow WY Unimp TAF 20773 11414 2287 3603 14088 9497 2517 2083 1933 3563 1294 2460 1155 3205 1109 2578	avg dflow WY Unimp A-J UNIMP TAF TAF  20773 11414 7004 2287 3603 2407 14088 9497 4922 2517 2083 1483 1933 3563 2424 1294 2460 1592 1155 3205 2568 1109 2578 1659	avg dflow WY Unimp A-J UNIMP 60-20-20 TAF TAF  20773 11414 7004 5446 2287 3603 2407 2404 14088 9497 4922 4306 2517 2083 1483 1861 1933 3563 2424 1964 1294 2460 1592 1514 1155 3205 2568 1955 1109 2578 1659 1558